CHAPTER 7

PLANTS, ANIMALS, AND WETLANDS

FINAL
ENVIRONMENTAL
IMPACT STATEMENT

Brightwater
Regional Wastewater
Treatment System

VOLUME 2

Contents

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Chapter 7
Plants, Animals, and Wetlands

7.1 Introduction

This chapter discusses the affected environment, impacts, and mitigation measures for plants, animals, and wetlands associated with the various Brightwater System alternatives. Please note that all references and figures cited in this chapter can be found at the end of the chapter.

7.1.1 Overview of the Chapter

This chapter contains several revisions that have been made since the Draft EIS to incorporate new project design information, reference new technical reports that have been completed, and incorporate new information to respond to comments on the Draft EIS. The chapter has also been reorganized, with the major emphasis now placed on three alternative "systems," which include a treatment plant, conveyance, and outfall.

King County received comments on the Draft EIS related to plants, animals, and wetlands from a number of federal, state, and local agencies; from public interest groups; and from individuals. Many questions, comments, and concerns fell into the following categories:

- Potential impacts to salmonids in various streams, such as Little Bear Creek
- More detailed information on site-specific impacts to vegetation, wetlands, fish, and wildlife in portal siting areas
- Concerns about and interest in stream daylighting/mitigation plans
- Impacts of stormwater runoff, spills, and leaks on streams and salmonids
- More information on special status species, such as surf smelt, bald eagle, rockfish, orcas, gray whales, and sea lions
- Impacts to benthic species, including shellfish, along the outfall corridor
- Distribution of sediment plumes during outfall construction
- More detailed information on outfall discharge impacts
- Proposed outfall monitoring measures and conceptual mitigation
- Best management practices (BMPs) for treatment plant, conveyance, and outfall construction

Information sources used in the preparation of this chapter include published reports by King and Snohomish Counties, Washington State Department of Fish and Wildlife (WDFW), Washington Department of Ecology (Ecology), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA) Fisheries, and other jurisdictions in the project area. Year 2002 aerial photographs and geographic information system (GIS) data from both King and Snohomish Counties were used for mapping habitats in the project area. Wetland, stream, and wildlife surveys were conducted at the treatment plant sites, and habitat reconnaissance visits were conducted along the corridors and at portal and pump station candidate sites. Extensive oceanographic, water quality and biological evaluations were conducted in and near outfall zones by King County as part of the Brightwater project. The chapter has been updated to include information from technical studies that were conducted after publication of the Draft EIS. These studies are included in Appendices 7-A through 7-F of this Final EIS:

- **Appendix 7-A, Affected Environment, Plants and Animals,** contains additional information on applicable regulations, on the affected environment along proposed conveyance corridors, and on marine species inhabiting the alternative outfall zones.

- **Appendix 7-B, Route 9 Site Sensitive Areas,** includes information on existing wetlands, wildlife habitat, and streams on the proposed Route 9 treatment plant site.

- **Appendix 7-C, Unocal Site Sensitive Areas,** includes information on existing wetlands, wildlife habitat, and streams on the proposed Unocal treatment plant site.

- **Appendix 7-D, Assessment of Potential Influence of Brightwater Discharges on Harmful Algal Blooms in Puget Sound**, assesses projected Brightwater effluent quality and the potential for treated effluent to contribute to the production of algal blooms that may be harmful to the public through water contact recreation or consumption of shellfish.

- **Appendix 7-E, Eelgrass Monitoring Survey Plan for the Brightwater Marine Outfall Alternatives,** includes information on proposed monitoring of eelgrass replanting as part of mitigation for impacts due to outfall construction.

- **Appendix 7-F, Eelgrass Survey Results for the Brightwater Marine Outfall Alternatives**, includes the results of recent additional eelgrass surveys that have been conducted in each alternative Brightwater outfall zone.

Where appropriate, sections of this chapter include references to appendices that provide more information on plant, animal, or wetland resources related to the treatment plant sites, conveyance corridors, and outfall zones.

7.2 Affected Environment

7.2.1 Affected Environment Common to All Systems

The following sections discuss plants, animals, and wetlands that occur on treatment plant sites, in portal siting areas, and throughout the general vicinity of outfall zones.

7.2.1.1 Regulatory Environment Common to All Systems

Table 7-1 provides a summary of statutes associated with potential impacts to plants, animals, and wetlands. Additional information on applicable regulations is provided in Appendix 7-A, Conveyance System and Outfall System Sensitive Areas.
The following sections discuss plants, animals, and wetlands that occur on treatment plant sites, along conveyance corridors and in portal siting areas, and throughout the general vicinity of the outfall zones.

7.2.1.2 Treatment Plant Affected Environment Common to All Systems

Conditions on both the Route 9 site and Unocal sites largely reflect the urbanized nature of these sites. Both sites contain substantial amounts of developed area, but also wetlands, streams, and other habitat areas. More information on each site is provided under the discussions of each system. Onsite habitats are shown in Figures 7-1 and 7-2.

Table 7-1. Statutes Associated with Potential Impacts to Plants, Animals, and Wetlands

Statute	Lead Agency	Regulated Activities
Federal – U.S. Army Corps of Engineers (COE)		
Section 10 of the Rivers & Harbors Act (33 USC 403)	COE – local district	Any work in or affecting navigable waters of the U.S. (such as piers, floats, outfalls, dredging). Navigable waters are those subject to the ebb and flow of the tide and/or are currently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Clean Water Act (CWA) Section 404 (33 USC 1344)	COE – local district	Discharge of dredged or fill material into waters of the U.S., including navigable waters and wetlands within Corps jurisdiction. Individual or nationwide permits are required, depending on project impacts.

Table 7-1. Statutes Associated with Potential Impacts to Plants, Animals, and Wetlands (cont.)

Statute	Lead Agency	Regulated Activities
Federal – U.S. Fish & Wildlife Service (USFWS) & National Oceanic and Atmospheric Administration (NOAA) Fisheries		
Endangered Species Act (ESA) (16 USC 1531)	USFWS & NOAA Fisheries	The ESA prohibits the "take" of listed species without a special permit. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt any of these actions. ESA review is required.
Marine Mammal Protection Act (MMPA) (16 USC 1361)	NOAA Fisheries	The MMPA prohibits the take of marine mammals without a permit.
Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801)	NOAA Fisheries	Purpose is to promote protection, conservation, and enhancement of Essential Fish Habitat (EFH). EFH includes those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The MSA requires all federal agencies to consult with NOAA Fisheries on all actions or proposed actions that are permitted, funded, or undertaken by the (federal) agency that may adversely affect designated EFH.
Migratory Bird Treaty Act (16 USC 703)	USFWS	The migratory bird treaty act prohibits the "take" of all birds, including their nests, eggs, and young, with the exception of the European starling, English sparrow, and domestic pigeon (non-native species).
Federal – Federal Highway Administration (FHWA)		
Section 4(f) of the Department of Transportation (DOT) Act, 49 USC 303	FHWA	Required when public parks, recreation areas, wildlife and waterfowl refuges, or any significant historic or archaeological sites of national, state, or local significance will be impacted when a federal permit or approval is required.
Federal – Miscellaneous		
Oil Pollution Act (33 USC Sec. 2701-2761)		Establishes provisions that improve the government's ability to respond to oil spills. Also requires contingency planning by both government and industry. There must be location-specific area contingency plans, and owners or operators of vessels and certain facilities that pose a serious threat to the environment must prepare their own facility response plans.
National Environmental Policy Act (NEPA) (42 USC 4321)	Federal agency pertinent to job type. For Brightwater, lead agency is likely to be COE.	NEPA review is required for projects that have a federal nexus such as federal funding or a federal permit.
National Historic Preservation Act (16 USC 470)	U.S. Department of the Interior, Advisory Council on Historic Preservation	Regulates actions licensed by the federal agencies that will have an effect on properties on or eligible for the National Register of Historic Places. Section 106 of the Act mandates the review process.

Table 7-1. Statutes Associated with Potential Impacts to Plants, Animals, and Wetlands (cont.)

Statute	Lead Agency	Regulated Activities
State – Washington State Dept. of Fish & Wildlife (WDFW)		
State Hydraulic Code/Hydraulic Project Approval (HPA) (RCW 75.20.100-160)	WDFW	Work that uses, diverts, obstructs, or changes the natural flow or bed of state waters. Activities include: bridges, piers, & docks; pile driving; channel change/realignment; pipeline crossing; culvert installation; dredging; gravel removal; pond construction; placement of outfall structures; log, log jam, or debris removal; installation/maintenance of water diversions.
State – Washington Office of Community Development (OCD)		
Growth Management Act (GMA) (RCW 36.70A)	OCD	The GMA stipulates that local agencies adopt regulations based on best available science that protect critical areas, including but not limited to, wetlands, streams, and fish and wildlife habitat areas.
State – Washington State Dept. of Natural Resources (WA DNR)		
Aquatic Lands Lease (RCW 79.90)	WA DNR	Temporary, long-term, or permanent use or encumbrance of state-owned aquatic land.
Forest Practices Act (RCW 76.09)	WA DNR	Forest practices including tree harvesting, salvaging trees, controlling brush, applying chemicals, and conversion of forest to non-forest use.
State – Washington State Dept. of Ecology (Ecology)		
Water Quality Certification Section 401 of the Clean Water Act (33 USC 1344)	Ecology	Applying for a federal license or permit to conduct any activity which may result in any discharge into the Waters of the United States or of the State of Washington, including regulated wetlands.
Coastal Zone Management Act Consistency Determination (CZMA) (16 USC 1451)	Ecology	A CZMA is triggered by one of three activities: • Activities undertaken by a federal agency • Activities requiring federal approval • Activities that use federal funding AND activities that are either in the coastal zone or that would impact coastal resources.
National Pollutant Discharge Elimination System (NPDES) Permit (RCW 90.48, 90.54)	Ecology	(1) Point source wastewater discharges to surface water from industrial facilities or municipal wastewater treatment plants, (2) Point source stormwater discharges to surface waters from industrial facilities and from construction sites of 1 or more acre, and (3) Stormwater discharges from municipal separate storm sewer systems that serve populations of 100,000 or more.
Floodplain Management Program	Ecology	Activities within the 100-year base floodplain as designated on Federal Emergency Management Agency (FEMA) maps.
Model Toxics Control Act (MTCA) (RCW 70.105D)	Ecology	Contaminated soils or groundwater.

Table 7-1. Statutes Associated with Potential Impacts to Plants, Animals, and Wetlands (cont.)

Statute	Lead Agency	Regulated Activities
Local (see Appendix 7-A, Affected Environment: Plants and Animals, for detailed information)		
Shoreline Management Act (RCW 90.58)	Local Jurisdiction	Work within 200 feet of Shorelines of the State. Shorelines of the State include rivers and streams where the mean annual flow is greater than 20 cubic feet per second, or lakes 20 acres or more in size and their associated wetlands.
Critical Areas Ordinances	Local jurisdiction	Project proposed near or within critical areas (wetlands, streams, steep slopes, and others) or their buffers.

Characterization of the affected environment on the treatment plant sites included a review of agency databases and maps (Snohomish County, 1987; USFS, 2003; WDFW, 2003a), and of technical studies documenting conditions on the sites. Past and present aerial photography was also used to document habitat changes and current habitat types on the sites (COE, 1944; King County, 2002b; Walker & Associates, 2003). Sensitive area studies from other developments were also reviewed.

Field surveys were conducted on the sites to evaluate habitat, wetland, and stream conditions. Habitat assessment methods described in *Wildlife–Habitat Relationships in Oregon and Washington* (Johnson and O'Neil, 2001) were used to describe and evaluate habitat types. Methods defined in the *Washington State Wetlands Identification and Delineation Manual* (Ecology, 1997), a manual consistent with the Corps of Engineers *Wetlands Delineation Manual* ("1987 Manual") (COE, 1987), were used to determine the presence and extent of wetlands on the sites. Wetland functions and values were assessed using the methodology presented in *Wetland Functions Characterization Tool for Linear Projects* (Null et al., 2000). Onsite streams were identified in the field and evaluated in accordance with the definitions described in Snohomish County Code (SCC) Chapter 32.10.110 (39) and the Edmonds Municipal Development Code Chapter 20.15B.020. Physical characteristics recorded included streamside riparian structure, large woody debris composition, and substrate conditions. Field investigations included consultations and field visits with the U.S. Army Corps of Engineers, Washington State Department of Ecology, Washington State Department of Fish and Wildlife, and Snohomish County.

Special Status Species

A variety of special status species potentially occur on terrestrial and freshwater portions of the treatment plant sites based on available habitat and individual species' habitat requirements. These species include those listed as state endangered, state threatened, state sensitive, or state candidate, as well as species federally listed as endangered or threatened or proposed for listing by the U.S. Fish and Wildlife Service or NOAA Fisheries. Special status species present or potentially occurring on or near candidate portal sites or in alternative outfall zones are discussed in following sections.

Special status species known to occur on each treatment plant site are discussed under each system in following sections of this chapter.

7.2.1.3 Conveyance Affected Environment Common to All Systems

Vegetation Cover/Habitat Types and Associated Animals

Wetlands, streams, and water bodies were identified on and directly adjacent to candidate portal sites for primary and secondary portal siting areas (PSAs). For the purposes of this Final EIS, aquatic resources have been assigned designations and numbers ("AR," followed by the aquatic resource number). Tables in the conveyance corridor sections, under discussions for each system, present the classifications, ratings, and local jurisdiction for each of these aquatic resources. Individual aquatic resources on and directly adjacent to candidate portal sites are labeled on Figures 7-3 through 7-23. These figures also show upland forest, designated as "highly vegetated area," on and near each portal siting area.

In addition to wetland, stream, and water body habitat types, upland habitat types were evaluated on and surrounding each of the candidate portal sites. Each of the portal siting areas contains predominantly medium- to high-density urban land uses. These land uses are referred to as "urban habitat," which primarily consists of single- and multi-family residences. Other urban habitats include business parks/commercial space (for example, Portal Siting Areas 5, 11, 13, 14, 33, and 41), retail centers (for example, Portal Siting Areas 10, 11, 13, 22, 23, 26, and 37), industrial areas (for example, Portal Siting Areas 7, 11, and 19), horse pastures (for example, Portal Siting Area 44), parks (for example, Portal Siting Areas 7, 10, 14, 26, 30, 41, and 45), school playgrounds (e.g., Portal Siting Area 7), and golf courses (for example, Portal Siting Area 27). Vegetation in urban habitat areas is typically sparse or disturbed and includes invasive and/or exotic plants (e.g., reed canarygrass and Himalayan blackberry), mowed lawns, pasture grass, landscape trees and shrubs, and occasional mature native trees and shrubs. These urban habitats function poorly to provide habitat for most native wildlife species.

Patches of wetlands, streams/riparian corridors, mature upland forests, and combinations of these habitat types exist throughout the portal siting areas. Mature upland forests are typically second- or third-growth forest and range between coniferous, deciduous, and mixed composition. Dominant tree species among mature upland forests include Douglas fir, western hemlock, western red cedar, alder, and big-leaf maple.

For both the Unocal and Route 9 conveyance corridors, a safety relief point would be located in Kenmore near the existing Kenmore Pump Station east of Juanita Drive NE and south of NE Bothell Way. For the Unocal corridor and the influent portions of the Route 9 corridors, this safety relief point would discharge untreated wastewater into the Sammamish River in the unlikely event that power outages and/or large storm events cause wastewater overflows. Discharge would occur about one-half mile upstream from the confluence of the Sammamish River with Lake Washington, with the discharge plume potentially extending downstream into the north end of Lake Washington. For more information, see Appendix 3-E, Flow Management and Safety Relief Point.

Sensitive areas in the vicinity of the safety relief point include the Sammamish River and patches of forested, scrub-shrub, and emergent riparian wetlands.

More information on wetlands, streams, water bodies, and upland habitat types is provided in Appendix 7-A, Affected Environment: Plants and Animals.

Fish Resources

Table 7-2 presents salmonid species documented as occurring in streams and water bodies on or adjacent to portal siting areas. Puget Sound chinook is listed as threatened by NOAA Fisheries and as candidate for listing as threatened by the Washington State Department of Fish and Wildlife (WDFW). Coho are candidate species for listing as threatened by NOAA Fisheries. Sockeye are listed as candidate species for listing as threatened by WDFW. In addition, Table 7-2 presents the habitat factors of decline for each named stream or water body on or adjacent to portal siting areas.

Special Status Species

Special status species include those classified as endangered, threatened, sensitive, or candidate by the Washington Department of Fish and Wildlife (WDFW), as well as species classified as endangered, threatened, candidate, or species of concern by the U.S. Fish and Wildlife Service (USFWS) or NOAA Fisheries.

For conveyance, a list of special status species and their potential occurrence is presented in Appendix 7-A, Affected Environment: Plants and Animals. The potential presence of species in portal siting areas was conservatively based on the presence of supporting habitat. Additional studies are necessary to determine whether or not these species actually exist in each area.

The WDFW Priority Habitats and Species (PHS) program has documented the occurrence of several special status species in the vicinity of portal siting areas, including bald eagles, chinook salmon, coho salmon, and sockeye salmon. Bald eagle nesting and/or foraging territories are documented in the vicinity of Portal Siting Areas 19 and 11. Bald eagles have been observed foraging in the vicinity of Portal Siting Area 27 over Lake Ballinger. A bald eagle nesting territory is located at the confluence of the Sammamish River with Lake Washington. Additional information on potential impacts and mitigation is provided under discussions of each system later in this chapter.

7.2.1.4 Outfall Affected Environment Common to All Systems

The two potential outfall zones, Zones 6 and 7S, contain a variety of marine habitat and organisms. The marine habitat types and the species that inhabit them are summarized below. Also included are discussions of species of special concern and tribal, commercial and recreational fishing. Additional information on the distribution of eelgrass in each.

Table 7-2. Habitat Factors of Decline for Salmonids Present in Streams and Water Bodies Near Portal Siting Areas

Stream or Water Body	Recently Documented Salmonid Presence[a]	Portal Siting Areas Near Stream or Water Body	Habitat Factors of Decline[c]
North Creek	Chinook[b], coho[b], sockeye[b], kokanee[b], steelhead, coastal cutthroat trout	37, 39, 41	Impassable culverts, transport of sediment from runoff, channel incision, lack of large woody debris recruitment and subsequent loss of channel complexity, cleared riparian zones, lack of stream canopy coverage, high seasonal stream temperature, low dissolved oxygen levels, increased frequency and duration of peak flows due to impervious surfaces within the drainage basin.
Swamp Creek	Chinook[b], coho[b], sockeye[b], kokanee[b], coastal cutthroat trout	12, 33, 44	Impassable culverts, transport of sediment from runoff, stream bank scouring and over-widening of the stream channel from storm events, channel incision, hardened streambanks, lack of large woody debris recruitment and subsequent loss of channel complexity, cleared riparian zones, lack of stream canopy coverage, high seasonal stream temperature, low dissolved oxygen levels, high concentrations of metals and diazinon, increased frequency and duration of peak flows due to impervious surfaces (approximately 52 percent) in the drainage basin.
Lyon Creek	Coho[b], sockeye[b], steelhead, coastal cutthroat trout	7, 10, 30	Impassable culverts, transport of sediment from runoff, hardened stream banks / loss of floodplain connectivity, lack of off-channel habitat, lack of large woody debris recruitment and subsequent loss of channel complexity, overdevelopment of riparian areas and lack of refugia, pesticide runoff from the drainage basin, high seasonal stream temperature.
McAleer Creek	Chinook[b], coho[b], sockeye[b], kokanee[b], steelhead, coastal cutthroat trout	5, 10, 26	Downstream of Interstate-5 (I-5), factors include an anadromous fish barrier (culvert) beneath I-5, transport of sediment from runoff and mass wasting, channel incision and erosion from storm events, lack of large woody debris recruitment and subsequent loss of channel complexity, high seasonal stream temperature, and increased frequency and duration of peak flows due to impervious surfaces (17-20 percent) in the drainage basin.
Sammamish River	Chinook[b], coho[b], sockeye[b], steelhead, rainbow trout, coastal cutthroat trout	11, 13, 14	Channel straightening, transport of sediment from runoff, lack of large woody debris recruitment and subsequent loss of channel complexity, overdevelopment of riparian areas and lack of refugia, lack of riverside canopy coverage, high seasonal temperature, non-native fish populations.
Lake Washington	Chinook[b], coho[b], sockeye[b], kokanee[b], steelhead, coastal cutthroat trout	11	Contaminants (e.g., pesticides), hardened shorelines, lack of native lakeside vegetation, increased predation mortality, loss of large woody debris, reduced shallow water habitat, disturbance of substrate composition in front of bulkheads, shading from overwater structures, lowered lake levels, non-native fish populations, increased lake temperature.
Puget Sound Drainages	Chinook[b], coho[b], chum, and coastal cutthroat trout	19	Impassable culverts, transport of sediment from runoff, overdevelopment of riparian areas and lack of refugia, pesticide runoff from drainage basin.

[a]Fevold et al. (2001); Kerwin (2001), King County (2002f), WDFW (2002a, 2002b).
[b]Special Status Species.
[c]Kerwin, 2001.

zone is provided in Appendix 7-F, Eelgrass Survey Results for the Brightwater Marine Outfall Alternatives (Parametrix and King County, 2003). Information on the affected environment was provided by site-specific evaluations conducted as part of King County's outfall siting studies, as well as by review of existing information collected by federal, state, and local resource agencies

Marine Habitat Types Common to All Systems

Marine habitats common to both outfall zones are discussed below under four sub-headings: (1) the riparian zone, or the interface between land and intertidal habitat; (2) the upper intertidal zone, or the uppermost intertidal habitat in which plants and animals are exposed during low tide; (3) the intertidal and shallow subtidal zone, where plants and animals may be exposed only during very low tides; and (4) the deep subtidal zone, where plants and animals are not exposed during low tides. Plants and animals inhabiting the water column are discussed separately from the habitats listed above. More detail is provided under the discussion of each outfall zone later in this chapter.

Riparian Zone

In general, the Puget Sound shoreline between Seattle and Everett has been highly modified by development, including railroad tracks (fill and riprap), residential development, and several industrial/commercial developments, such as the facilities at Point Wells and on the Unocal site. These developments have replaced native vegetation, such as salt-tolerant plants found on less developed sites, which would otherwise grow at the highest tide elevations and in adjacent upland areas. Riparian zone vegetation is discussed in more detail under the Unocal and Route 9 systems.

Upper Intertidal Zone

The upper intertidal zone in the vicinity of the alternative outfall zones typically consists of gravel and coarse sand beaches. Data from the 1999 Shorezone Database (WA DNR, 1999) indicate that most of the shoreline is bordered by riprap. As mentioned above, some areas with seawalls border the shoreline and there is little vegetation in the upper intertidal area in either zone.

Intertidal and Shallow Subtidal Zones

Intertidal and shallow subtidal zones in outfall Zones 6 and 7S contain a variety of substrate types and vegetation. This nearshore environment, which includes areas in less than approximately 80 feet of water, provides productive habitat and is important for rearing of many species of fish and shellfish, including salmonids and many of their food sources.

There are two types of aquatic plants, sea lettuce and eelgrass, that predominate in both outfall zones and their surrounding areas. Sea lettuce (predominantly *Ulva lactuca*) is found almost continuously along the shoreline of the eastern Central Basin of Puget

Sound. Sea lettuce typically attaches to pebbles or larger-sized substrata but may also be found in viable free-floating patches deposited along beaches.

Intertidal eelgrass (predominately *Zostera marina*) is common in both outfall zones but is patchy is some areas (Figure 7-24). Eelgrass occurs in shallow soft bottom tide flats, along channels, and in the shallow subtidal fringe. Eelgrass communities serve as habitat for various species and provide feeding and refuge habitats for fish and invertebrates (Dethier, 1990).

A nearshore habitat survey conducted by King County found moderate amounts (10 – 50 percent coverage) of eelgrass throughout most of Zone 7S from the intertidal zone down to approximately –20 feet mean lower low water (MLLW) and patches of dense eelgrass (greater than 50 percent coverage) in the shallow subtidal zone (shallower than –30 feet MLLW) (Woodruff et al., 2001). Eelgrass on the southern side of the Unocal pier in Zone 6 was found to be patchy (Pentec, 1995; Woodruff et al., 2001) (Figure 7-24). The northern portion of Zone 6 and a small area of 7S were not included in the nearshore habitat survey because of survey vessel mobility restrictions near the piers. An additional eelgrass survey was conducted in 2003 along the potential outfall alignment in each zone and is discussed in Appendix 7-F (Figures 7-25 through 7-27). Information on eelgrass distribution in these areas is discussed in more detail in the outfall sections for the Route 9 and Unocal systems.

Both outfall zones also contain a variety of kelp species. Kelp beds provide habitat for a variety of fish species, herring spawning substrate, and refuge for a variety of crabs and shrimps. Young rockfish common to the Central Basin of Puget Sound (brown, copper, and quillback) are commonly found in kelp beds prior to moving to more typical adult rocky reef habitat (West, 1997). The most common types of kelp in the Central Basin are sugar kelp (*Laminaria* spp.) and bull kelp (*Nereocystis luetkeana*). These species, however, are rare throughout most of the area in both alternative outfall zones. Because kelp needs to attach to stable rocks, distribution coincides with the more typical rocky substrates found in deeper intertidal and shallow subtidal habitats in other areas of Puget Sound. A nearshore habitat survey conducted in 1999 found only three small patches of bull kelp in Zone 7S (Woodruff et al., 2001) (Figure 7-24). The recent eelgrass survey conducted in July and August 2003 along the proposed outfall alignments in each zone did not note any bull kelp within 100 feet on either side of each alignment. Although not quantitative, a survey for juvenile rockfish habitats conducted in 1991 and 1992 found bull kelp in the northern area of Point Wells, but the area in Zone 7S was not included in this survey (Doty et al., 1995). The distribution of kelp beds, particularly bull kelp, is known to vary over time in Puget Sound (Shaffer, 1998).

Intertidal and shallow subtidal substrate in the alternative outfall zones consists mainly of sand with some areas of mixed cobbles, gravel, and shell fragment (Woodruff et al., 2001). Tideflats, consisting of unconsolidated sands, silts, and clays, occur throughout the area and are widest in the middle portions of embayments, such as near Richmond Beach in Zone 7S (Armstrong et al., 1976). Benthic infaunal communities contain amphipods and other crustaceans, as well as many species of bivalves (Armstrong et al., 1976; Word et al., 1981).

Deep Subtidal Zone

Habitat in the deep subtidal zone (water depths extending from -30 to -80 feet MLLW) consists of substrates composed primarily of silty and sandy sediments. There are no benthic macroalgae or seagrasses in this zone, because not enough light penetrates to the bottom to support macroalgae growth. A variety of benthic infauna is found in these areas. Sediment sampling in both outfall zones in 2001 identified the clam *Macoma carlottensis* and the crustacean *Euphilomedes producta* as the dominant organisms (King County, 2002g). These two organisms are typically found in the type of substrate, silt, and sand that dominate the deep subtidal areas in the two alternative outfall zones. Sediment monitoring conducted by Ecology in 1998 at two sites close to the outfall zones (Station numbers 121 and 123) found species assemblages similar to those identified in 2001 by King County and typical of sediments in deep subtidal areas (Long et al., 2000). Over 200 benthic infaunal species have been identified in sediments near the outfall zones. A complete species list may be found in the *Baseline Sediment Characterization Study for the Brightwater Marine Outfall* (King County, 2002g), *Richmond Beach Sewage Outfall Survey: A Survey of Benthic Subtidal Communities* (Word et al., 1981), and *Sediment Quality in Puget Sound, Year 2-Central Puget Sound* (Long et al., 2000). Other organisms such as benthic macroinvertebrates (geoduck clam, horse clam, spot prawn, pandalid shrimp, Dungeness crab, red rock crab, anemones, and sea stars), fish, and marine mammals may be found in deep subtidal habitats and are discussed in more detail below.

Water Column

A wide variety of organisms inhabit Puget Sound and may use waters in and around the alternative outfall zones at some stage in their lifecycle. Certain fish or birds may be more prevalent over specific types of bottom habitats; for example, rockfish are more common over rocky reefs than in sandy flats. However, because these organisms are highly mobile, it is assumed that they occur throughout the alternative outfall zones.

Marine Fish Resources Common to All Systems

Many fish species inhabit Puget Sound, including waters in the vicinity of the alternative outfall zones. Fish use waters and habitat in Puget Sound for a variety of purposes, including spawning, rearing, feeding, and migration. These uses vary depending on time of year and the location, both within the water column and throughout the Sound.

Fish use can be characterized according to those uses that occur in the nearshore (intertidal) area of the water column, and those that occur in offshore (subtidal) areas. Following is a summary of fish use in or near the alternative outfall zones.

Fish in the Nearshore Area

Sand lance (*Ammodytes hexapterus*) and surf smelt (*Hypomesus pretiosus*) are generally found in nearshore areas (Figure 7-28). Both species are a prey item for seabirds, marine

mammals, and a variety of fishes. From November 2000 to February 2001 and again from November 2001 to February 2002, King County conducted sand lance and surf smelt spawning surveys on beaches in the vicinity of the alternative outfall zones. Documented sand lance spawning habitat was found at Picnic Point, Ocean Avenue, Point Wells, Brackett's Landing, and Deer Creek (Figure 7-28). Documented surf smelt spawning habitat was found at Picnic Point, Point Wells, Edwards Point, and Deer Creek (Figure 7-28) (King County, 2002a).

Although there are known Pacific herring spawning grounds in the Central Basin of Puget Sound, none are within the alternative outfall zones (Striplin et al., 2001). Female herring deposit eggs primarily on eelgrass and other aquatic plants down to a depth of approximately –40 feet MLLW. Although this type of spawning habitat is present along the alternative outfall zones, Pacific herring spawning grounds have not been documented along the entire eastern portion of the Central Basin likely due to the open coastline and the lack of quiescent bays with macroalgae (Lassuy, 1989).

Rock sole (*Lepidopsetta bilineata*) and English sole (*Pleuronectes vetulus*) are flatfish that are commonly associated with sand or mud bottoms that can range from shallow to deep waters. Adult rock sole usually inhabit waters shallower than 650 feet (often in waters less than 50 feet deep); adult English sole primarily inhabit shallow waters during the summer, extending down to 800 feet during the winter (Battelle et al., 2001). Juveniles of both species are abundant in nearshore areas. Nearshore fish surveys conducted in 2001 between May and October found both English and rock sole to be prevalent at sites surveyed along the eastern shoreline including the areas in and around the outfall zones (King County, 2002a).

Several species of rockfish (*Sebastes* spp.) may be found in waters around the alternative outfall zones. Brown, copper, and quillback rockfish are the most common rockfish species found in the Central Basin of Puget Sound. Both brown rockfish (*Sebastes auriculatus*) and copper rockfish (*Sebastes caurinus*) are often found around piers and in bays. Juveniles may use shallow nearshore areas as nursery grounds. Nearshore fish surveys conducted between May and October in 2001 and 2002 at several nearshore locations in both the western and eastern portions of the Central Basin found very few juvenile rockfish (only six for both years sampled) and none in or near the alternative outfall zones (Higgins, personal communication, 2003). However, previous surveys conducted in 1991 and 1992 observed juvenile rockfish in vegetated habitats in and near the alternative outfall zones (Doty et al., 1995). Adult copper and quillback (*Sebastes maliger*) rockfish have been found in shallow waters near the alternative outfall zones (Edwards Point and Point Wells) (Striplin et al., 2001). Both brown and copper rockfish are solitary and tend to stay near the bottom in rocky areas with caves and crevices. Adult quillback rockfish prefer rocky areas and hard, even bottoms around 45 feet deep, but have been found as deep as 825 feet (Striplin et al., 2001).

Eight species of salmonids use nearshore areas of Puget Sound at some point in their life cycle. These include chinook, chum, coho, sockeye, and pink salmon and searun cutthroat, steelhead, and bull trout (Striplin et al., 2001). Salmonids use nearshore areas for adapting from freshwater to saltwater, for migration, as nursery areas, for juvenile and

adult feeding, and as residence and refuge. Chinook, chum and pink salmon and cutthroat trout use nearshore habitats more than do other species (Battelle et al., 2001). Nearshore area surveys conducted in 2001 found juvenile coho, chinook, sockeye, and chum salmon, along with cutthroat and steelhead trout at several locations in the vicinity of the outfall zones (King County, 2002a).

Other fish species observed in nearshore areas in the vicinity of the outfall zones include perch (shiner, striped, and pile), starry flounder, speckled sanddab, sculpins (great, northern, buffalo, and tidepool), gunnels (penpoint, saddleback, and crescent), tubesnout, stickleback, cabezon, ratfish, greenling, and skates (King County, 2002a; Taylor Associates, 2002; Woodruff et al., 2001).

Fish in Offshore Areas

Offshore waters in the alternative outfall zones provide habitat for a variety of fish, including salmonids. Salmonid stocks that may be present near the alternative outfall zones include runs from the Skagit and Stillaguamish Rivers, but mostly from the Snohomish, Green, Puyallup, and Nisqually Rivers and smaller drainages in Central and southern Puget Sound.

Marine Mammals and Birds Common to All Systems

Many marine birds and mammals frequent Puget Sound waters in the alternative outfall zones for a variety of purposes, including feeding and migration. Use varies depending on time of year and the location. Table 7-3 provides a summary of marine birds and mammals that have been observed in or near the alternative outfall zones. Because these are mobile species, it is assumed that if they are observed in the vicinity of the outfall zones, it is likely that they also use habitat within the outfall zones. More marine birds have been observed in Zone 6 than in Zone 7S, probably because of the ease of public access and frequent sightings in that area by local birding groups.

Table 7-3. Marine Birds and Mammals Observed in or Near Alternative Outfall Zones

Species	Scientific Name	Common Name	Reference
Marine Mammals	*Eumetopias jubatus*	Steller sea lion	Striplin et al. 2001
	Zalophus californianus	California sea lion	King County 2001
	Phoca vitulina	Pacific harbor seal	King County 2001
	Orcinus orca	Killer whale	Striplin, et al. 2001
	Phocoenoides dalli	Dall's porpoise	King County 2001
	Eschrichtius robustus	Gray whale	King County 2001
Marine Birds	*Uria aalge*	Common murre	King County 2001; Audubon Society 2002
	Histrionicus histrionicus	Harlequin duck	King County 2001; Audubon Society 2002
	Brachyramphus marmoratus	Marbled murrelet	King County 2001; Audubon Society 2002
	Gavia immer	Common loon	King County 2001; Audubon Society 2002
	Melanitta perspicillata	Surf scoter	PAS 2002; Audubon Society 2002
	Aechmophorus occidentalis	Western grebe	PAS 2002; Audubon Society 2002
	Podilymbus podiceps	Pied-billed grebe	Audubon Society 2002
	Podiceps auritus	Horned grebe	PAS 2002; Audubon Society 2002
	Podiceps grisegena	Red-necked grebe	PAS 2002; Audubon Society 2002
	Phalacrocorax pelagicus	Pelagic cormorant	PAS 2002; Audubon Society 2002
	Phalacrocorax auritus	Double-crested cormorant	PAS 2002; Audubon Society 2002
	Ardea herodias	Great blue heron	PAS 2002; Audubon Society 2002
	Branta canadensis	Canada goose	PAS 2002; Audubon Society 2002
	Branta bernicla	Brant	Audubon Society 2002
	Melanitta nigra	Black scoter	PAS 2002; Audubon Society 2002
	Melanitta fusca	White-winged scoter	PAS 2002
	Aythya marila	Greater scaup	Audubon Society 2002
	Bucephala albeola	Bufflehead	PAS 2002; Audubon Society 2002
	Anas americana	American wigeon	PAS 2002; Audubon Society 2002
	Bucephala clangula	Common goldeneye	PAS 2002; Audubon Society 2002

Table 7-3. Marine Birds and Mammals Observed in or Near Alternative Outfall Zones (cont.)

Species	Scientific Name	Common Name	Reference
Marine Birds	*Bucephala islandica*	Barrow's goldeneye	PAS 2002; Audubon Society 2002
	Mergus serrator	Red-breasted merganser	PAS 2002; Audubon Society 2002
	Mergus merganser	Common merganser	Audubon Society 2002
	Haliaeetus leucocephalus	Bald eagle	PAS 2002; Audubon Society 2002
	Ceryle alcyon	Belted kingfisher	Audubon Society 2002
	Calidris alba	Sanderling	PAS 2002; Audubon Society 2002
	Calidris alpina	Dunlin	Audubon Society 2002
	Calidris mauri	Western sandpiper	Audubon Society 2002
	Larus californicus	California gull	PAS 2002; Audubon Society 2002
	Larus philadelphia	Bonaparte's gull	Audubon Society 2002
	Larus glaucescens	Glaucous-winged gull	PAS 2002; Audubon Society 2002
	Larus thayeri	Thayer's gull	PAS 2002; Audubon Society 2002
	Larus delawarensis	Ring-billed gull	Audubon Society 2002
	Larus argentatus	Herring gull	Audubon Society 2002
	Larus occidentalis	Western gull	Audubon Society 2002
	Larus canus	Mew gull	PAS 2002; Audubon Society 2002
	Cerorhinca monocerata	Rhinocerus auklet	Audubon Society 2002
	Cepphus columba	Pigeon guillemot	PAS 2002; Audubon Society 2002

PAS = Pilchuck Audubon Society

Marine Mammals Common to All Systems

Killer Whales

The southern resident killer whale (*Orcinus orca*) community occasionally enters inland Puget Sound waters, particularly in the fall months when the whales are following the returning salmon runs. This whale community is made up of three distinct groups or pods of whales, including the J, K, and L pods. The J pod is the group most commonly observed in Central Basin of Puget Sound. In the last several years there have been over 40 sightings of killer whales in or near the alternative outfall zones from September through May, although most sightings were in the fall (King County, 2001). The diet of southern resident killer whales consists primarily of salmonid prey, although other fish such as lingcod, halibut, flatfish, greenling, and squid may also be taken. chinook salmon appear to be the preferred prey for whales feeding in Puget Sound waters (King County, 2001).

Although rare to inland Puget Sound waters and with no confirmed sightings in the vicinity of the alternative outfall zones, it is possible for transient killer whales to travel through waters near the alternative zones. Transient whales differ from resident whales in behavior and diet. Transient whales travel in small groups of less than five individuals and mainly feed on other marine mammals.

Minke Whales

The minke whale (*Balaenoptera acutorostrata*) is the smallest baleen whale and appears to be a solitary species. Minke whales have been reported year-round in Puget Sound and the Strait of Juan de Fuca, but most sightings are between March and November (King County, 2001). In inland Puget Sound waters, minke whales tend to be most common around the San Juan Islands, and a small number of whales are believed to return annually to these waters to feed between spring and fall. Minke whales feeding in the San Juan Islands appear to be concentrated in waters between 60 and 300 feet deep. Prey species include juvenile herring and sand lance (King County, 2001). There have been no recorded sightings of minke whales near the vicinity of the outfall zones in the last several years, but it is possible that they may travel through the area.

Gray Whales

The gray whale (*Eschrictius robustus*) is a baleen whale that feeds primarily in shallow areas close to shore by sucking up sand and mud from the seafloor and filtering out small invertebrates, such as amphipods, shrimps, and worms. Gray whales may occasionally enter inland Puget Sound waters on their migrations from breeding grounds in Mexico to their feeding grounds in the Bering Sea and Alaska. It is mainly in the spring and summer when a small number of gray whales may enter inland Puget Sound waters and spend extended periods feeding. Gray whale use of central Puget Sound waters is highly variable, although a consistent group of whales has returned annually to feed in the waters near Whidbey Island (King County, 2001). In the last several years, there have

been over 30 sightings of gray whales near the alternative outfall zones, with most observations reported between March and May (King County, 2001).

Dall's Porpoise

The Dall's porpoise (*Phocoenoides dalli*) is one of the most abundant cetaceans in the inland marine waters of Washington and is observed year-round in Puget Sound. Dall's porpoises are observed at all water depths, but sightings are more frequent in deeper waters (over approximately 150 feet) where they are also known to breed (King County, 2001). These porpoises feed primarily on squid and small schooling fish. There have been several sightings of Dall's porpoises in the vicinity of the alternative outfall zones for the past several years (King County, 2001).

Pacific Harbor Seal

The Pacific harbor seal (*Phoca vitulina richardsi*) is distributed along the entire west coast of North America and is the most abundant marine mammal in Washington. They are considered non-migratory and generally breed and feed in the same areas throughout the year, although they may move seasonally in response to prey abundance. Harbor seals are present year-round mainly in nearshore habitats but will use buoys and other structures in deeper waters as haul-outs. They are opportunistic feeders preying on a wide variety of benthic and epibenthic fish and cephalopods. Pacific hake, cod, and walleye pollock are the most frequent prey items (King County, 2001).

California Sea Lion

The California sea lion (*Zalophus californianus*) breeds off the coast of California and Mexico; only sub-adult and adult males enter inland Puget Sound waters during the fall months before returning to breeding rookeries in the late spring. These sea lions use jetties, offshore rocks, log booms, marina docks, and buoys as haul-out sites. In Puget Sound, the main haul-out area is located in the Shilshole Bay Marina (King County, 2001). California sea lions are opportunistic feeders, preying on a variety of fish and squid, including Pacific hake, walleye pollock, Pacific herring, and spiny dogfish (King County, 2001).

Steller Sea Lion

The Steller sea lion (*Eumetopias jubatus*) is the largest of the eared seals and occurs in small groups in Puget Sound. They are often seen at haul-out sites with California sea lions. Although single animals may occasionally be seen in inland Puget Sound waters throughout the year, they are most often observed from early fall to early spring and are seldom seen during the summer months (Striplin et al., 2001). Steller sea lions forage mainly in nearshore areas at relatively shallow depths feeding primarily on Pacific hake. Other prey items include Pacific herring, spiny dogfish, skates, surf smelt, and salmon (Striplin et al., 2001).

Marine Birds Common to All Systems

Many marine birds use waters in and near the alternative outfall zones. A complete list of marine birds observed in or near each outfall zone is provided in the discussions of each alternative system later in this chapter. A brief discussion is provided below of marine birds considered as a species of concern, either federally under the Endangered Species Act or by Washington State, that may occur in the alternative outfall zones.

Common Murre

Common murres (*Uria aalge*) are pelagic birds that are permanent residents of the Washington coast. They are observed most frequently in the San Juan Islands, Strait of Juan de Fuca, and in smaller numbers in Puget Sound. Common murres spend most of the year on open waters and come to shore only to nest in breeding colonies in June and July. This species generally appears in Puget Sound waters in late summer and fall as the coastal colonies disperse (Striplin et al., 2001). Common murres are diving birds and typically dive to a depth of approximately 40 to 90 feet to feed on small schooling fish such as sand lance, surf smelt, and capelin (Striplin et al., 2001). Common murres have been observed in and near the alternative outfall zones during WDFW winter and summer surveys, and also during annual Christmas Bird Count surveys (Striplin et al., 2001).

Harlequin Duck

Harlequin ducks (*Histrionicus histrionicus*) are residents of Puget Sound that use rivers and streams in early spring for breeding and for migrating to coastlines where they occupy shallow intertidal areas. They are diving ducks and will flip over cobbles and rocks in search of prey, but will also forage at the surface in search of insects. While on wintering grounds in marine waters, harlequin ducks feed on marine invertebrates such as crabs, amphipods, barnacles, and snails. Other prey items include chitons, limpets, mussels, and occasionally small fish and fish eggs (Striplin et al., 2001). Often found in shallow waters over eelgrass and kelp communities, this species is also associated with cobble and rocky nearshore areas. Harlequin ducks have been observed near the alternative outfall zones during WDFW winter surveys and also during annual Christmas Bird Count surveys (Striplin et al., 2001).

Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) is a small seabird that spends most of its life on the ocean and in nearshore marine waters, moving inland to nest in trees. In Puget Sound, marbled murrelets often nest inland in large conifers associated with old-growth forests from mid-April to late September. This species is a year-round visitor to Puget Sound, although they are typically more abundant in fall and winter. They feed primarily on small crustaceans such as euphausiids and amphipods, but also prey on surf smelt, Pacific herring, rockfish, squid, and shrimp (Striplin et al., 2001). No marbled murrelets were observed during WDFW winter or summer surveys near the alternative outfall zones (Striplin et al., 2001). Occasionally during some years of the annual

Christmas Bird Count surveys, a few marbled murrelets (usually 1 to 3 birds) have been observed near the alternative outfall zones (Striplin et al., 2001).

Bald Eagle

The bald eagle is listed as a federal and state threatened species. Bald eagles are both residents in and migrants through the Puget Sound region. Eagle populations are usually highest in the region in the winter months, when both resident birds and winter migrants are present due to the mild winter climate and abundant fall salmon runs (WDFW, 2001b). Bald eagles generally perch, roost, and build nests in mature trees near water bodies and available prey, usually away from intense human activity. They prey on a variety of foods including fish, birds, mammals, carrion, and invertebrates. In the Puget Sound region, waterfowl and fish are generally the most common food for eagles (Watson, 2002). Bald eagles typically return to one of several nests located within an established nesting territory (Stalmaster, 1987). Their seasonal home range for foraging and nesting averages 1.8 square miles in this region (Watson, 2002).

Marine Benthic Macroinvertebrates Common to All Systems

Representative benthic macroinvertebrate species with particular commercial, social, or ecological importance in the alternative outfall zones are discussed below.

Dungeness Crab

Dungeness crabs (*Cancer magister*) are typically found in sandy bottom, subtidal waters and in sandy-muddy areas that contain eelgrass. In Puget Sound, Dungeness crabs are found in waters ranging to -300 feet MLLW but are most common from approximately -9 to –185 feet MLLW (King County, 2001). Dungeness crabs prey and scavenge on a variety of benthic species, such as fish, other crabs, and worms, but commonly feed on small clams (King County, 2001). As with other crabs, Dungeness crab larvae are planktonic before settling out in intertidal areas in mid-to-late summer. Dungeness crabs can be expected to occur in the alternative outfall zones at depths typically seen in other parts of the Central Basin of Puget Sound over similar substrate. They have also been harvested commercially and recreationally in and near both alternative outfall zones.

Red Rock Crab

Red rock crabs (*Cancer productus*) are more abundant in intertidal areas than are Dungeness crabs and are commonly associated with rock/gravel substrates, although they may also occur in sandy and muddy areas containing eelgrass. Red rock crabs prey and scavenge on a variety of benthic species, including clams, mussels, snails, and other crabs. Like Dungeness crab, this species also has planktonic larvae that settle out as juveniles in intertidal to shallow subtidal areas. Red rock crabs are expected to occur in the alternative outfall zones and have been harvested recreationally in and near both alternative outfall zones.

Shrimp

Several species of shrimp inhabit Puget Sound waters, including pink, humpback, dock, and coonstripe shrimp, as well as spot prawns (also known as spot shrimp). Spot prawn (*Pandalus platyceros*), the largest of the pandalid shrimps, is the most important commercial and recreational harvested shrimp species in Puget Sound. Adult spot prawns inhabit discrete areas called beds and are typically found in waters between depths of -185 to -285 feet MLLW in Central Puget Sound (King County, 2002c). Spot prawn habitat requirements depend on the developmental stage of the animal. Adults occupy deeper waters, while juveniles are known to use shallower waters where vegetation is present. Larval spot prawns are planktonic before settling out in shallow nearshore areas. Spot prawns exhibit seasonal migrations from deep to shallow waters; they can also migrate vertically in the water column (King County, 2002c). They are benthic feeders foraging mainly at night and prey on mysid and other shrimps, amphipods, small mollusks, fish carcasses, and worms. Spot prawns are known to occur in the alternative outfall zones and there are commercial, tribal, and recreational spot prawn fisheries in or near both outfall zones.

Clams

There are several clam species inhabiting Puget Sound waters, including horse or gaper, manila, native littleneck, butter, cockle, and geoduck clams. Manila (*Venerupis philippinarum*), native littleneck (*Protothaca staminea*), butter (*Saxidomus gigantea*), horse (*Tresus capex*), and cockle (*Clinocardium nuttalli*) clams are found in intertidal sand and in sand-gravel substrate in both of the alternative outfall zones, with butter and horse clams being the most abundant. Manila clams are typically found in intertidal habitat, whereas native littlenecks can occur from the mid-intertidal down to shallow subtidal areas. Butter clams can inhabit low intertidal down to subtidal areas (Harbo, 1999). Horse and geoduck (*Panopea abrupta*) clams are found in both zones but can occur in deeper waters than other clam species. Geoduck clams can occur from low intertidal areas down to a depth of over 300 feet (King County, 2001). The small clam *Macoma carlottensis* dominates deeper subtidal areas in the vicinity of both proposed outfall zone diffuser locations. Clams have planktonic larvae that settle onto the bottom and crawl until they find a suitable habitat. They then attach themselves by a filament and burrow into the substrate after reaching sufficient size.

Geoducks are an important commercial and recreational species in Puget Sound. A geoduck distribution and biomass survey conducted in the alternative outfall zones showed that geoducks are widely distributed throughout the area surveyed, from –70 feet MLLW up to the lower edge of the intertidal zone. The average density for the entire area surveyed from north of Edmonds to south of Richmond Beach County Park was 0.84 geoducks per square meter, with more geoducks occurring in the area north of Zone 7S and north of Zone 6 (Golder and Parametrix, 2002) (Figure 7-29). Geoduck density increased with depth while geoduck biomass (weight) decreased with depth (more geoducks, but smaller).

Marine Special Status Species Common to All Systems

There are several USFWS federally listed threatened or endangered species that may inhabit marine waters in the project area. Threatened species include the bald eagle (*Haliaeetus leucocephalous*), bull trout (*Salvelinus confluentus*), and marbled murrelet (*Brachyramphus marmoratus*). Bald eagles are known to be present in nearshore areas of the Central Basin of Puget Sound, although there are no known eagle nests on land immediately adjacent to the outfall zones. There are, however, three bald eagle nests located within one mile of Portal 19 (Zone 7S), and documented eagle nests one mile north and 0.5 mile south of the Unocal site (Zone 6). As discussed above, marbled murrelets are observed intermittently in inland Puget Sound waters; winter and summer surveys by WDFW conducted in the outfall zones found no murrelets in winter and only a few birds in the Everett area in summer (Striplin et al., 2001). Bull trout are known to use nearshore areas as foraging grounds and migration corridors.

There are also a number of NOAA federally threatened species that may occur in or in the vicinity of the outfall zones, including Puget Sound chinook salmon, Steller sea lion, and chum salmon (Hood Canal summer run). Coho salmon are currently a candidate species for listing. Chinook, chum, and coho salmon require varied habitats during different phases of their life. Adults use nearshore areas as migration corridors when returning from the oceanic life stage, while juveniles reside in the nearshore prior to their out-migration. Steller sea lions, as discussed above, are commonly observed in the Central Basin of Puget Sound.

Washington State special status species that may occur in nearshore areas include peregrine falcon, pileated woodpecker, Vaux's swift, merlin, purple martin, great blue heron, green heron, western big-eared bat, Keen's myotis, long-eared bat, and long-legged bat.

Commercial and Treaty Tribal Fisheries Common to All Systems

Current commercial fisheries near the alternative outfall zones include fisheries for salmon, Dungeness crab, spot prawns, and spiny dogfish. Areas in the vicinity of both outfall zones are also adjudicated as a treaty-protected "usual and accustomed" fishing/shellfishing area for several Puget Sound area treaty tribes. The State of Washington and treaty tribes regulate commercial fisheries in these areas.

For salmon, the alternative outfall zones fall into two WDFW management areas: Salmon Management Area 9, located north of the Edmonds Marina (Zone 6); and Salmon Management Area 10, located south of the marina (Zones 6 and 7S) (Figure 7-30). Fishing quotas and fishery open dates are determined each year, based on return projections calculated by WDFW and tribal government fisheries managers. The coho season extends from roughly mid-September to early October, and the chum season extends from October through November. Salmon Management Area 9 is usually closed to non-treaty tribal commercial salmon fishing; therefore, the northern border of Salmon Management Area 10, located south of the Edmonds Marina, is a popular location for

coho salmon fishing. Many treaty tribes are involved in fishing in this area, mostly in the vicinity of Point Edwards (FHWA et al., 1998).

Dungeness crab is the only commercially harvested crab species in Puget Sound, with the commercial harvest usually extending from October to April. Occasionally there are commercial harvest openings for short periods during the summer and at other times of the year. The alternative outfall zones are within the WDFW Crustacean Management Region 4, Catch Area 26B (Zone 7S) and Management Region 2W, Catch Area 26A, which is on the northern border of Zone 6 (Figure 7-30). Most of the commercial harvest for Dungeness crab occurs north of Everett (Striplin et al., 2001); however, commercial harvesting does occur near Edmonds in Catch Area 26A. The commercial fishery in Catch Area 26B is currently closed to commercial harvest. There is a tribal fishery for Dungeness crab in both Catch Areas 26A and 26B that is open year-round.

There is a commercial spot prawn fishery (both state and tribal) in Puget Sound, including in the vicinity of the alternative outfall zones (King County, 2002a). The management regions and catch areas are the same as those for Dungeness crab. The state commercial fishery remains open for 1 to 2 months, typically from June until the end of July. The tribal fishery is an open-access fishery, as opposed to a permit fishery where catch quotas are allocated to individuals. The quota is typically reached quickly and the fishery lasts approximately two weeks per season (King County, 2002a). Catch Areas 26A and 26B are two areas that open early to spot prawn fishing if test fishing shows that fewer than 2 percent of the females have eggs. Under these conditions, fishing is allowed in these two areas from approximately April 11 through October 15, or until quotas are reached. Spot prawns are fished more intensely in the vicinity of Zone 6 than Zone 7S (King County, 2002a).

There is currently a commercial spiny dogfish fishery in Central Puget Sound. Fishing typically occurs from Possession Bar south to Port Madison. The primary fishing gear used is long line, but set nets may also be used. While the fishery is open year-round, most fishing occurs in the spring and fall. The fishery generally occurs in water depths between -100 to -300 feet MLLW (Bargmann, personal communication, 2003).

Recreational (Sport) Fisheries Common to All Systems

Sport fishers in Puget Sound target a wide range of salmonids, including coho salmon, king salmon (adult chinook), steelhead trout, pink salmon, cutthroat trout, and blackmouth (immature chinook). Fishing intensity is highest in the fall when salmon return to spawn in tributary streams and rivers. Sport fishing activity in the vicinity of the alternative outfall zones is generally concentrated off Edwards Point just north of the ferry terminal, off Jefferson Head, and off Possession Point (Parametrix, 2001a; King County, 2002i). Sport fishing pressure in Salmon Management Zones 9 and 10 is intense due to their proximity to the Seattle metropolitan area. Over 100,000 angler trips per year are made each in Salmon Management Areas 9 and 10, some of which originate from the Edmonds Marina (WA DNR, 1977; Haw and Buckley, 1973; Evergreen Publishing, 1989). Several species of fish are caught off the Edmonds fishing pier north of Zone 6,

including smelt, chinook and pink salmon, rockfish, and perch (WDFW, 2003b). Invertebrates collected from the fishing pier include squid, shrimp, and red rock and Dungeness crabs. Clams are also collected in this area.

The central Puget Sound bottomfish sport fishery is also active. Historically, the most important fish species were rockfish, flatfish, Pacific cod, sablefish, and walleye pollock. Populations of many of these fish species have significantly declined in recent years, particularly Pacific cod, walleye pollock and Pacific whiting (hake), which have all been rated as "critical" or "depressed" by WDFW (PSWQAT, 2000).

Although not recommended by the Washington State Department of Health because of water quality concerns, recreational shellfishing occurs along many central Puget Sound shorelines, particularly at public access beaches such as Richmond Beach Park, Marina Beach Park, and Meadowdale Beach Park. Harvesting for clams and crabs occurs frequently during low tides at these beaches (Parametrix, 2001a; King County, 2002i).

Recreational fishing for spot prawns is an active fishery that typically opens in late April and remains open for about 2 weeks. The area near the Edmonds Marina is a popular area for spot prawn fishers.

There is a recreational squid fishery in the Central Basin of Puget Sound that typically occurs from late fall through March. Fishing occurs at night; lights are used to attract squid. Squid fishing frequently occurs in areas with public fishing piers.

7.2.2 Affected Environment: Route 9 Systems

The following section describes plants, animals, and wetlands in and around the components of the Route 9 System—the treatment plant site, conveyance corridors, and outfall zone.

7.2.2.1 Treatment Plant Affected Environment: Route 9

Most of the Route 9 site is developed in commercial and industrial land uses. However, the northern portion of the site contains upland forest, grassland, wetlands, and streams. Numerous watercourses are piped through the developed portions of the site, and a natural stream is located near the southern boundary of the site. Onsite habitat areas have been fragmented and affected by pollutants, noise, and other disturbances from onsite and nearby commercial and industrial developments, including roads and highways. The total site area is approximately 114 acres, approximately 37 acres of which are vegetated habitat. Little Bear Creek is located adjacent to the site, on the west side of SR-9.

Vegetation Cover/Habitat Types and Associated Animals: Route 9 Treatment Plant

Six habitat types were identified on the Route 9 site (Figure 7-1): (1) developed areas; (2) upland forest; (3) upland grassland; (4) forested/scrub-shrub wetland and riparian; (5) emergent wetland; and (6) open water wetland. These habitat types are also summarized in Table 7-4. Habitats and associated wildlife species are described in more detail in Appendix 7-B, Route 9 Sensitive Areas Technical Report.

Table 7-4. Habitat Types on the Route 9 Site

Habitat Type	Description	Area (acres)	Location on Site
Developed areas	Industrial and commercial buildings, auto wrecking yards, industrial storage areas, gravel and paved parking lots.	77	South and central portions
Upland forest	Dominant trees include red alder, western red cedar, big leaf maple, Douglas fir, western hemlock, and black cottonwood; the age of forest patches varies throughout the site, from saplings to mature stands.	29	North and south portions
Upland grassland	On disturbed, fill soils dominated by bentgrass, velvetgrass, and a mix of weedy herbs.	3.2	North portion– former Northshore School District property
Forested/scrub-shrub wetland and riparian	Dominant species vary by wetland area and include red alder, reed canarygrass, western red cedar, black cottonwood, species of willows, salmonberry, skunk cabbage, and bentgrass.	3.6	North portion
Emergent wetland	Dominated by dense reed canarygrass and bentgrass, with patches of soft rush and creeping buttercup.	1.3	North portion– former Northshore School District property
Open water wetland	Newly constructed fish rearing pond.	0.4	North portion – northeast corner of Woodinville North Joint Venture property

Special Status Species: Route 9 Treatment Plant

No plants with special status are documented on or near the Route 9 site. For wildlife, bald eagle, bull trout, and marbled murrelet are all documented in the larger region in which the Route 9 site and other components of the Brightwater System would be located (USFS, 2003). Bald eagles may be attracted to fish or waterfowl prey on the detention ponds or in Little Bear Creek adjacent to the site, and local residents have noted that bald eagles are observed in the area on a regular basis (Hensley Letter I408 in Response to Comments on Brightwater Draft EIS). The closest documented bald eagle nest is located near the north shore of Lake Sammamish, approximately 3 miles south of the Route 9 site (WDFW, 2003a). There is no documented habitat for marbled murrelet on or

immediately adjacent to the Route 9 site. Lake Washington is located in the range of the Coastal/Puget Sound distinct population segment (DPS) of bull trout; however, no occurrences of or habitat for bull trout has been documented in Little Bear Creek.

According to NOAA Fisheries, Puget Sound chinook occur on or near the Route 9 site. Salmon spawning survey data from WDFW for 1952 through 2000 demonstrate that low numbers of chinook salmon spawn in Little Bear Creek; the first record is from 1971 (David Evans and Associates, 2002). Chinook adults were identified during 2001 stream surveys south of NE 205th Street on the lower portion of Little Bear Creek, approximately 0.5 mile downstream from the Route 9 site (Foley, personal communication, 2001). Small numbers of chinook (breeding aggregations of populations in WRIA 8) may spawn in Little Bear Creek near the site; they are sighted occasionally upstream of NE 205th Street. Coho salmon, a candidate for federal Endangered Species Act listing, have also been documented in Little Bear Creek. Coho salmon have access to the fish-rearing pond (Wetland E) segment of 228th Street Creek.

Several other special status species may occur on the site. A comprehensive list and description of special status species that may occur on or in the vicinity of the Route 9 Treatment Plant site is included in Appendix 7-B, Route 9 Site Sensitive Areas Technical Report. Of these, signs of pileated woodpecker foraging are present in forested habitats on the site.

Wetlands: Route 9 Treatment Plant

Five wetlands (Wetlands A through E) have been identified on the north portion of the Route 9 site (Figure 7-1). Wetlands on the Route 9 site are derived primarily from groundwater seeps and springs. Wetlands A, B, C, and E are also associated with streams. Vegetation community types in wetlands include forested, scrub-shrub, emergent, and open water habitats. Wetlands are described in Table 7-5. Additional detail from field studies conducted in 2003 is provided in Appendix 7-B, Route 9 Sensitive Areas Technical Report.

Fish Resources: Route 9 Treatment Plant

The Route 9 site contains three natural streams: (1) Howell Creek, (2) 228th Street Creek (two channels), and (3) Unnamed Creek (Figure 7-1). Additionally, there are six other watercourses that are contained in pipes or excavated ditches on the site. A seventh watercourse, (Watercourse 9) is a small tributary to Unnamed Creek. Refer to Chapter 6 for a more detailed description of watercourses on the Route 9 site. The onsite streams and watercourses ultimately flow into Little Bear Creek, a tributary to the Sammamish River within the Lake Washington Drainage Basin. Little Bear Creek is located adjacent to the site immediately west of SR-9.

Table 7-5. Wetland Classifications and Descriptions for the Route 9 Site

Wetland	Wetland Size (Acres)	Hydro-Geomorphic (HGM) Classification	Associated Streams	USFWS (Cowardin) Class [a]	Ecology Rating [b] (Category)	Snohomish County Rating	Snohomish County Buffer (feet)	Vegetation (dominant species)	Mapped Soil Type [c]	Observed Soils
A	0.5 (onsite)	Depressional outflow	Unnamed Creek	PFO	II	2	75	Red alder black cottonwood western red cedar salmonberry youth-on-age	McKenna gravelly silt loam, Norma loam, Alderwood gravelly sandy loam	Silty clay loam to loam
B	0.26	Depressional outflow	Unnamed Creek	PFO	III	3	50	Similar to Wetland A	McKenna gravelly silt loam	Gravelly sandy loam
C	3.14	Slope and Depressional outflow	228th Street Creek, Channel A	PEM PFO	II	2	75	Reed canarygrass bentgrass western red cedar red alder salmonberry	Norma loam, Alderwood gravelly sandy loam	Fill material and loam
D	0.97	Depressional outflow	None	PSS	III	3	50	Sitka willow Pacific willow red alder black cottonwood	McKenna gravelly silt loam, Norma loam	Fill material and loam
E	0.14	Depressional outflow	228th Street Creek	POW	III	3	25[d]	willow soft rush	Everett gravelly sandy loam	-

[a] U.S. Fish and Wildlife Service wetland classifications: PEM-Palustrine Emergent, POW–Palustrine Open Water, PSS-Palustrine Scrub Shrub, PFO-Palustrine Forest, (Cowardin et al., 1985).
[b] Ecology (1993).
[c] Debose and Klungland, (1983).
[d] Wetland E is located within the Urban Growth Area(UGA). Class 3 wetlands in the UGA are regulated by buffer widths of 25 feet.

Snohomish County rates Little Bear Creek adjacent to the Route 9 site as a Type 2 water. The 150-foot and 300-foot buffers on Little Bear Creek as specified by Snohomish County Code extend onto the Route 9 site.

The 228th Street Tributary, up through the fish-rearing pond, and Howell and Unnamed Creeks, up to SR-9, are rated by Snohomish County as Type 3. Daylighted reaches of the 228th Street Tributary, Unnamed Creek, and Howell Creek, located on the Route 9 site, are rated Type 4. The six other watercourses on the site are not regulated by Snohomish County at this time; however, WDFW and the U.S. Army Corps of Engineers may ultimately regulate these watercourses.

No fish use has been documented in Howell Creek on the Route 9 site. However, coho and cutthroat trout are known to use the segment of Howell Creek in the Washington State Department of Transportation Native Growth Protection Area between SR-9 and Little Bear Creek.

Lower reaches of the 228th Street Tributary are accessible to coho salmon (and other salmonids) in the fish-rearing pond (Wetland E) (Wood-McGuiness, personal communication, 2002). A fish blockage elbow has been placed in the Wetland C culvert, which flows into the fish-rearing pond from its northwest corner, preventing salmonid access into the wetland and in Channel A of 228th Street Creek (Caine, personal communication, 2002) (Figure 7-1). It is unknown to what extent juvenile salmonid fish use the rearing pond. Anecdotal observations have noted small fish within the pond, but the species type and overall abundance of these fish are unknown. Juvenile salmonids (unidentified species) were observed in small pools of the fish ladder during a May 2002 site visit. Low water quality and high summer temperatures are anticipated to limit year-round use of the pond by salmonids.

Fish habitat is limited in Unnamed Creek because of culvert blockages downstream and a long piped section onsite, the lack of habitat features such as pools and large woody debris, and high gradients on the site. Talasaea Consultants (2003) observed juvenile trout downstream of the piped stream section near SR-9 where water was backed up behind a culvert under SR-9 in October 2002.

No fish are known to occur in the six other watercourses on the site. Because they are primarily piped and/or ditched, no fish habitat likely exists in these watercourses.

Little Bear Creek, located adjacent to the site, contains habitat for and breeding aggregations of Puget Sound chinook, coho, sockeye, and kokanee salmon and coastal cutthroat trout populations. Habitat limiting factors include the following:

- A total of 88 potential barriers to migrating adult fish along the entire length of Little Bear Creek during periods of low flow and to juveniles during high flows
- Low pool frequencies
- Lack of conifers in riparian areas
- High levels of impervious surfaces basin-wide, causing altered hydrologic regimes and base flows
- Violation of state Water Quality Standards due to low dissolved oxygen, fecal coliform levels, pesticides, and other toxicants (Kerwin, 2001)

7.2.2.2 Conveyance Affected Environment: Route 9

Route 9–195th Street Corridor: Affected Environment

The Route 9–195th Street corridor consists of both an influent portion leading to the Route 9 site and an effluent portion leading from the site to Zone 7S off Point Wells.

Streams on or adjacent to primary and secondary candidate portal sites include Little Swamp Creek and tributaries, North Creek, an unnamed tributary to the Sammamish River, an unnamed tributary to Lake Washington, the west fork of Lyon Creek, two unnamed tributaries to Lake Ballinger, an unnamed tributary to Puget Sound, and Barnacle Creek (tributary to Puget Sound). Most of the wetlands potentially affected are located in riparian areas of these streams and include forested, scrub-shrub, and emergent vegetation communities. See Figures 7-3 through 7-23.

Five primary portals (Portals 11, 41, 44, 5, and 19) have been identified for the 195th Street corridor, although not expected to be used. No aquatic resources were identified in Portal Siting Areas 5 or 11. Four secondary portals (Portals 45, 7, 27, and 23) are identified for this corridor. No aquatic resources were identified in Portal Siting Area 23. Tables 7-6 and 7-7 summarize aquatic resources on primary and secondary candidate portal sites in portal siting areas.

Portal 41 Influent Pump Station Option

The affected environment for an influent pump station on the 195th Street corridor is the same as that described for Portal Siting Area 41 in Table 7-6. All of the candidate portal sites being considered are in a highly urban area and are largely developed:

- Site A is the most highly disturbed and is bordered on the north and west perimeters by North Creek and its modest riparian corridor.
- A mixed coniferous and deciduous forest habitat occupies the eastern portion of Site C.
- A tributary to the Sammamish River borders the west side of Site D and the east side of Site J.
- Site W contains disturbed scrub-shrub and emergent wetlands.
- Site X does not contain sensitive areas.

Table 7-6. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Primary Portal Sites on the 195th Street Corridor

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
11	A, B, and C	--	None identified	--	--	--	--	--
44	C	67c	Little Swamp Creek	R2SB	–	–	City of Kenmore	2
		57a	Wetland	PFO, PSS, PEM	Riverine	2	City of Kenmore	2
	D	67c	Little Swamp Creek	R2SB	–	–	City of Kenmore	2
		57c	Wetland	PFO, PSS, PEM	Riverine	2	City of Kenmore	2
	E	58	Wetland	PFO, PEM	Riverine	2	City of Kenmore	2
41	A	130	Wetland	POW, PSS	Depressional	3	City of Bothell	2
		61b	North Creek	R2SB	–	–	City of Bothell	1
		53	Wetland	PSS, PEM	Riverine	1	City of Bothell	1
	C	–	None Identified	–	–	–	–	–
	D	52a	Tributary to Sammamish River	R2SB	–	–	City of Bothell	2

Table 7-6. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Primary Portal Sites on the 195th Street Corridor (cont.)

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
41	W	155	Wetland	PEM, PSS	Slope	3	City of Bothell	3
		156	Wetland	PEM, PSS	Slope	3	City of Bothell	3
	X	None identified	–	–	–	–	–	–
	J	52a	Tributary to Sammamish River	R2SB	–	–	City of Bothell	2
5	B, G, and X	–	None Identified	–	–	–	–	–
19	A	138	Stream	R2SB	–	–	Town of Woodway	3
		139	Wetland	PSS	Slope		Town of Woodway	3
	C	138	Stream	R2SB	–	–	Town of Woodway	3
		139	Wetland	PSS	Slope		Town of Woodway	3
		97	Stream	R2SB	–	–	Town of Woodway	3
		147	Wetland	PEM	Riverine	3	Snohomish County (urban)	3

Table 7-6. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Primary Portal Sites on the 195th Street Corridor (cont.)

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
19	E	97	Stream	R2SB	–	–	City of Shoreline	3
		137	Barnacle Creek	R2SB	–	–	City of Shoreline	3
		140	Wetland	PSS	Riverine	3	City of Shoreline	3

[a]Figures 7-3 through 7-23 depict aquatic resource [AR] identification and aerial photographs for each portal siting area.
[b]Candidate portal sites are a minimum of 1 acre each. Figures 7-3 through 7-23 depict AR identification and aerial photographs for each candidate portal site.
[c] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.
[d]U.S. Fish and Wildlife Service classifications describe the dominant vegetation structure in the wetland. Major groupings are palustrine [freshwater wetland (PFO = forested, PSS = scrub-shrub, PEM = emergent, POW = open water)]; riverine [stream or river (R2SB = lower perennial, R3SB = upper perennial, R4SB = intermittent, R2UB = unconsolidated bottom)]; estuarine [coastal wetlands with saltwater and tidal influences (E2EM = intertidal emergent)]; and lacustrine [lakes (L1OW = limnetic {deep} open water, L2OW = littoral {shallow} open water)]. (Cowardin et al. 1985).
[e]HGM classifications describe the position in the landscape occupied by the wetlands. Major groups include *depressional* = occupying a geographic depression; *riverine* = associated with a stream or river; *lacustrine* = associated with a lake; *estuarine* = under tidal influence*;* and *sloped* = hillside seeps (COE, 1993).
[f]These ratings were developed by the Washington State Department of Ecology based on functional attributes that wetlands provide. Class 1 wetlands have highly valued functions, whereas Class 3 wetlands provide minimal functional value (Ecology, 1993). These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.
[g]Local ratings are based on applicable city, town, and county regulations, which were developed in a manner similar to the Ecology ratings. Details on the underlying rationale for and implications of these ratings can be found in Appendix 7-A, Affected Environment: Plants and Animals. These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.

Table 7-7. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Secondary Portal Sites on the 195th Street Corridor

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification [d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
45	A	142	Wetland	PFO	Depressional	3	City of Kenmore	2
	C	143	Wetland	PFO	Slope	3	City of Lake Forest Park	2
	D	144	Wetland	PFO	Slope	3	City of Kenmore	2
		145	Wetland	PFO	Riverine	3	City of Kenmore	2
		146	Stream	–	–	–	City of Kenmore	2
7	A	–	None identified		–	–	–	–
	B	79	Brugger's Bog	PSS	Riverine	2	City of Shoreline	3
		77	West Fork of Lyon Creek	R2SB	–	–	City of Shoreline	2
	C	79	Brugger's Bog	PSS	Riverine	2	City of Shoreline	3
		77	West Fork of Lyon Creek	R2SB	–	–	City of Shoreline	2
27	A	83b	Lake Ballinger	L2OW	–	–	City of Mountlake Terrace	no rating
		83a	Tributary to Lake Ballinger	R2SB	–	–	City of Mountlake Terrace	no rating
	B	141	Wetland	PFO, PEM	Slope	3	City of Shoreline	2
	C	83b	Lake Ballinger	L1OW, L2OW	--	--	City of Edmonds	no rating
		92	Wetland	L2AB, L2EM	Lacustrine fringe	1	City of Edmonds	1

Table 7-7. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Secondary Portal Sites on the 195th Street Corridor (cont.)

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification [d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
23	A, D, and F	–	None identified	–	–	–	–	–

[a]Figures 7-3 through 7-23 depict aquatic resource [AR] identification and aerial photographs for each portal siting area.
[b]Candidate portal sites are a minimum of 1 acre each. Figures 7-3 through 7-23 depict AR identification and aerial photographs for each candidate portal site.
[c] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.
[d]U.S. Fish and Wildlife Service classifications describe the dominant vegetation structure in the wetland. Major groupings are palustrine [freshwater wetland (PFO = forested, PSS = scrub-shrub, PEM = emergent, POW = open water)]; riverine [stream or river (R2SB = lower perennial, R3SB = upper perennial, R4SB = intermittent, R2UB = unconsolidated bottom)]; estuarine [coastal wetlands with saltwater and tidal influences (E2EM = intertidal emergent)]; and lacustrine [lakes (L1OW = limnetic {deep} open water, L2OW = littoral {shallow} open water)]. (Cowardin et al. 1985).
[e]HGM classifications describe the position in the landscape occupied by the wetlands. Major groups include *depressional* = occupying a geographic depression; *riverine* = associated with a stream or river; *lacustrine* = associated with a lake; *estuarine* = under tidal influence*;* and *sloped* = hillside seeps (Brinson, 1993).
[f]These ratings were developed by the Washington State Department of Ecology based on functional attributes that wetlands provide. Class 1 wetlands have highly valued functions, whereas Class 3 wetlands provide minimal functional value (Ecology, 1993). These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.
[g]Local ratings are based on applicable city, town, and county regulations, which were developed in a manner similar to the Ecology ratings. Details on the underlying rationale for and implications of these ratings can be found in Appendix 7-A, Affected Environment: Plants and Animals. These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.

Route 9–228th Street Corridor: Affected Environment

The Route 9–228th Street corridor includes several of the same elements as the 195th Street corridor: the Route 9 treatment plant site, the influent portion of the corridor, and the outfall zone.

Streams on or adjacent to candidate portal sites associated with the corridor include Little Swamp Creek and tributaries, North Creek, Palm Creek, Swamp Creek, an unnamed tributary to Swamp Creek, the east fork of Lyon Creek, Hall Creek, an unnamed tributary to the Puget Sound, and Barnacle Creek (tributary to Puget Sound). Most of the wetlands potentially affected are riparian to these streams and include forested, scrub-shrub, and emergent vegetation communities.

Seven primary portals (Portals 11, 41, 44, 39, 33, 26, and 19) are proposed for the 228th Street corridor. Portal 41 influent pump station (IPS) option information is the same as described for the Route 9–195th Street corridor. Four secondary portals (Portals 37, 30, 24, 22) are also proposed for the 228th Street corridor. Tables 7-8 and 7-9 provide summaries of aquatic resources present on each primary and secondary candidate portal site in portal siting areas.

7.2.2.3 Outfall Affected Environment: Route 9

The shoreline in the vicinity of Zone 7S consists of shrubs and some deciduous trees. Point Wells is composed of a natural point of land that was reinforced with a rubble seawall by the railroad more than 100 years ago. The Chevron Richmond Beach Asphalt Terminal barge dock is located immediately north of the zone.

The upper intertidal zone in Zone 7S consists mainly of sand with large woody debris in the form of driftwood in northern portions of the zone. There is little upper intertidal sand in most of the zone due to the riprap bordering the railroad tracks. Several seawalls from residential dwellings border southern portions of the zone. Barnacles are common on riprap and other boulders in this habitat zone.

An extensive characterization of nearshore vegetated habitat specific to each alternative outfall zone was completed to assess the extent of priority habitats within each zone. The nearshore habitat survey found moderate amounts of eelgrass throughout most of Zone 7S from the intertidal area down to approximately -20 feet MLLW and patches of dense eelgrass in the shallow subtidal zone (Woodruff et al., 2001). The southern section of Zone 7S contains a broad band of moderate to dense eelgrass that is up to 1,000 feet wide (cross-shelf) (Figure 7-24). An additional eelgrass survey was conducted in August 2003 to assess eelgrass distribution in the area not surveyed during the 1999 study because of sampling constraints. Habitat along the preferred alignment at Point Wells, as well as 105 feet on either side of the alignment, was surveyed for quantitative eelgrass distribution. Eelgrass distribution was found to be patchy to the north of the alignment and slightly wider and more continuous south of the alignment. Eelgrass was present between water depths of -1.5 MLLW to approximately -15 MLLW. In areas where eelgrass was present, the density

Table 7-8. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Primary Portal Sites on the 228th Street Corridor

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
39	B	34a	Palm Creek	R2SB	–	–	City of Bothell	2
	C and D	–	None identified	–	–	–	City of Bothell	–
33	A	12	Tributary to West Fork of Swamp Creek	R2SB	–	–	City of Brier	no rating
		12a	Wetland	PFO	Riverine	1	City of Brier	1
	C	13	Wetland	PFO, POW	Depressional	3	Snohomish County (urban)	3
	D	67a	West Fork of Swamp Creek	R2SB	–	–	City of Brier	no rating
26	A	4	Hall Creek	R2SB	–	–	City of Mountlake Terrace	no rating
	C	–	None identified	–	–	–	–	–
	D	4	Hall Creek	R2SB	–	–	City of Mountlake Terrace	no rating
		5	Wetland	PSS, POW	Riverine	2	City of Mountlake Terrace	no rating
11 19 41	See Table 7-6.							

Table 7-8. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Primary Portal Sites on the 228th Street Corridor (cont.)

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
44	See Table 7-6.							

[a]Figures 7-3 through 7-23 depict aquatic resource [AR] identification and aerial photographs for each portal siting area.
[b]Candidate portal sites are a minimum of 1 acre each. Figures 7-3 through 7-23 depict AR identification and aerial photographs for each candidate portal site.
[c] Refers to wetlands, streams, and other aquatic resources show on Figures 7-3 through 7-23.
[d]U.S. Fish and Wildlife Service classifications describe the dominant vegetation structure in the wetland. Major groupings are palustrine [freshwater wetland (PFO = forested, PSS = scrub-shrub, PEM = emergent, POW = open water)]; riverine [stream or river (R2SB = lower perennial, R3SB = upper perennial, R4SB = intermittent, R2UB = unconsolidated bottom)]; estuarine [coastal wetlands with saltwater and tidal influences (E2EM = intertidal emergent)]; and lacustrine [lakes (L1OW = limnetic {deep} open water, L2OW = littoral {shallow} open water)]. (Cowardin et al. 1985).
[e]HGM classifications describe the position in the landscape occupied by the wetlands. Major groups include *depressional* = occupying a geographic depression; *riverine* = associated with a stream or river; *lacustrine* = associated with a lake; *estuarine* = under tidal influence*;* and *sloped* = hillside seeps (Brinson, 1993).
[f]These ratings were developed by the Washington State Department of Ecology based on functional attributes that wetlands provide. Class 1 wetlands have highly valued functions, whereas Class 3 wetlands provide minimal functional value (Ecology, 1993). These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.
[g]Local ratings are based on applicable city, town, and county regulations, which were developed in a manner similar to the Ecology ratings. Details on the underlying rationale for and implications of these ratings can be found in Appendix 7-A, Affected Environment: Plants and Animals. These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.

Table 7-9. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Secondary Portal Sites on the 228th Street Effluent Corridor

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
37	A	148	Wetland	PEM, PSS	Riverine	3	City of Bothell	2
	C	149	Wetland	PEM, POW	Depressional	4	City of Bothell	3
		150	Wetland	PEM	Depressional	3	City of Bothell	3
	D	21	Wetland	PFO	Riverine	2	City of Bothell	2
		23a	Perry Creek	R2SB	–	–	City of Bothell	2
		132a	Stream	R2SB	–	–	City of Bothell	2
		134	Wetland	PFO	Depressional	3	City of Bothell	2
30	A	8	East Fork of Lyon Creek	R2SB	–	–	City of Brier	no rating
		9	Wetland	PFO	Riverine	3	City of Brier	3
	B	8	East Fork of Lyon Creek	R2SB	–	–	City of Brier	no rating
		131	Wetland	PSS	Depressional	4	City of Brier	4
	C	8	East Fork of Lyon Creek	R2SB	–	–	City of Brier	no rating
		9a	Wetland	PFO	Riverine	3	City of Brier	3

Table 7-9. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Secondary Portal Sites on the 228th Street Effluent Corridor (cont.)

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
24	A, B, C	–	None identified	–	–	–	–	–
22	A, C, D, E, F	--	None identified	--	--	--	--	--

[a]Figures 7-3 through 7-23 depict aquatic resource [AR] identification and aerial photographs for each portal siting area.
[b]Candidate portal sites are a minimum of 1 acre each. Figures 7-3 through 7-23 depict AR identification and aerial photographs for each candidate portal site.
[c] Refers to wetlands, streams, and other aquatic resources show on Figures 7-3 through 7-23.
[d]U.S. Fish and Wildlife Service classifications describe the dominant vegetation structure in the wetland. Major groupings are palustrine [freshwater wetland (PFO = forested, PSS = scrub-shrub, PEM = emergent, POW = open water)]; riverine [stream or river (R2SB = lower perennial, R3SB = upper perennial, R4SB = intermittent, R2UB = unconsolidated bottom)]; estuarine [coastal wetlands with saltwater and tidal influences (E2EM = intertidal emergent)]; and lacustrine [lakes (L1OW = limnetic {deep} open water, L2OW = littoral {shallow} open water)]. (Cowardin et al. 1985).
[e]HGM classifications describe the position in the landscape occupied by the wetlands. Major groups include *depressional* = occupying a geographic depression; *riverine* = associated with a stream or river; *lacustrine* = associated with a lake; *estuarine* = under tidal influence*;* and *sloped* = hillside seeps (Brinson, 1993).
[f]These ratings were developed by the Washington State Department of Ecology based on functional attributes that wetlands provide. Class 1 wetlands have highly valued functions, whereas Class 3 wetlands provide minimal functional value (Ecology, 1993). These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.
[g]Local ratings are based on applicable city, town, and county regulations, which were developed in a manner similar to the Ecology ratings. Details on the underlying rationale for and implications of these ratings can be found in Appendix 7-A, Affected Environment: Plants and Animals. These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future

averaged 10.3 shoots/0.25 m^2 (Figures 7-25 and 7-26). Throughout the entire area surveyed, eelgrass density averaged 2.3 shoots/0.25 m^2 (Parametrix and King County, 2003). Eelgrass distribution mirrors the bathymetry of the area, with the outer edges of the eelgrass beds following the depth contours. Comprehensive results of the eelgrass survey are provided in Appendix 7-F, Eelgrass Survey Results for the Brightwater Marine Outfall Alternatives.

The 1999 nearshore habitat survey also identified three small patches of bull kelp in the northern portions of Zone 7S. During the 2003 habitat survey along the preferred alignment, two to three individual stipes of bull kelp were observed in subtidal waters. These plants were attached to small cobble and were most likely transient through the area or are rare recruits from floating kelp mats washed to shore from other locations. Though not common, a few blades of sugar kelp were also observed scattered in the survey area (Parametrix and King County, 2003). Continuous bands of dense sea lettuce are located in the northern portion of Zone 7S in the intertidal zone, with moderate amounts in the southern portion and shallow subtidal areas (Woodruff et al., 2001). Overall, sea lettuce distribution is patchier in the middle and southern portions of the zone. The 2003 habitat survey along the preferred alignment also found bands of sea lettuce with higher densities in shallow intertidal areas (Parametrix and King County 2003). Other algal species found comprising less than 5 percent of the algal cover along the preferred alignment area included red alga (*Mastocarpus papillatus* and *Sarcodiotheca* sp.) (Parametrix and King County, 2003).

Intertidal sediments in Zone 7S are composed of 96 to 99 percent sand and gravel (King County, 2001; King County, 2002g), while shallow subtidal sediments are comprised of 92 to 95 percent sand (King County, 2002g). Bottom sediments in the deep subtidal zone are comprised of 81 to 84 percent sand and silt (King County, 2002g).

A wide variety of organisms are found in the vicinity of Zone 7S (Table 7-10). Fewer marine birds have been observed in Zone 7S than in Zone 6 due to the ease of public access and frequent outings by local birding groups in Zone 6. The lack of direct sightings does not preclude their presence in the area. A larger list of marine organisms than those listed in Table 7-10 is provided in Appendix 7-A, Affected Environment: Plants and Animals. Because many species are mobile, it is assumed that organisms observed in the vicinity of the outfall zone may also use habitats contained within the zone. Biota observed in nearshore and offshore sediments are typical of other areas with similar substrates. A comprehensive list of benthic infauna found in offshore sediments may be found in the *Baseline Sediment Characterization Study for the Brightwater Marine Outfall* (King County, 2002g), while a list of nearshore biota may be found in *The Shoreline Biota of Puget Sound: Extending Spatial and Temporal Comparisons* (Dethier and Schoch, 2000).

Table 7-10. Animals Observed in or Near Outfall Zone 7S

Species	Habitat area observed	Reference
Fish		
Chum, coho, chinook salmon *	Intertidal/shallow subtidal	King County 2002c
Sockeye salmon *	Intertidal/shallow subtidal	King County 2002c
Cutthroat, steelhead trout *	Intertidal/shallow subtidal	King County 2002c
Shiner, striped, pile perch	Intertidal/shallow subtidal	King County 2002c
English, rock sole	Intertidal/shallow subtidal	King County 2002c
Starry flounder	Intertidal/shallow subtidal	King County 2002c
Speckled sanddab	Intertidal/shallow subtidal	King County 2002c
Staghorn, great, northern sculpin	Intertidal/shallow subtidal	King County 2002c
Surf smelt	Intertidal/shallow subtidal	King County 2002c
Pacific herring *	Intertidal/shallow subtidal	King County 2002c
Penpoint, saddleback gunnel	Intertidal/shallow subtidal	King County 2002c
Tubesnout	Intertidal/shallow subtidal	King County 2002c
Threespine stickleback	Intertidal/shallow subtidal	King County 2002c
Pipefish	Intertidal/shallow subtidal	King County 2002c
Skate	Intertidal/shallow subtidal	King County 2002c
Greenling	Intertidal/shallow subtidal	Woodruff et al. 2001
Cabezon	Intertidal/shallow subtidal	Woodruff et al. 2001
Lingcod	Intertidal/shallow subtidal	Woodruff et al. 2001
Ratfish	Intertidal/shallow subtidal	Woodruff et al. 2001
Macroinvertebrates		
Geoduck clam *	Intertidal/shallow subtidal	Golder and Parametrix 2002
Horse clam	Intertidal/shallow subtidal	Golder and Parametrix 2002
Sea cucumber	Intertidal/shallow subtidal	Woodruff et al. 2001
Various anemones	Intertidal/shallow subtidal	Woodruff et al. 2001
Sea pen	Intertidal/shallow subtidal	Woodruff et al. 2001
Dungeness crab *	Intertidal/shallow subtidal	Woodruff et al. 2001
Various sea stars *	Intertidal/shallow subtidal	Woodruff et al. 2001

Table 7-10. Animals Observed in or Near Outfall Zone 7S (cont.)

Species	Habitat area observed	Reference
Marine Mammals *		
Killer (orca) whale	Deep subtidal	Striplin et al., 2001
Gray whale	Deep subtidal	King County, 2001a
Dall's porpoise	Deep subtidal	King County, 2001a
Steller sea lion	Deep subtidal	Striplin et al., 2001
Harbor seal	Deep subtidal	King County, 2001a
California sea lion	Deep subtidal	King County, 2001a
Birds *		
Common murre	Deep subtidal	Striplin et al., 2001
Marbled murrelet	Intertidal/shallow subtidal	Striplin et al., 2001
Harlequin duck	Intertidal/shallow subtidal	Striplin et al., 2001
Caspian tern	N/A	Pilchuck Audubon Society 2002
Glaucous-winged gull	N/A	Pilchuck Audubon Society 2002
Herring gull	N/A	Pilchuck Audubon Society 2002

* Indicates that while the species was observed in this habitat area, it may also occur in other areas of the outfall zone.
N/A = information not available.

7.2.3 Affected Environment: Unocal System

7.2.3.1 Treatment Plant Affected Environment: Unocal

The 53-acre Unocal site is located between SR-104 and the Edmonds Marina. The central portion of the site is developed with formerly used storage tanks, gravel areas, and a few small buildings. Since 1923, onsite habitat areas have been fragmented and affected by pollutants, noise, and other disturbances from adjacent industrial activities. Upland forest areas are located on the slope between Puget Sound and the location of the former storage tanks, and between and east of the tank sites. The forested slope above Puget Sound is part of a larger wildlife movement corridor along Puget Sound. The Edmonds Marsh extends onto the site from the northeast; portions of Willow Creek and Shelleberger Creek are also located within the northeast site boundary. Overall, the site contains approximately 25 acres of vegetated habitat.

Vegetation Cover/Habitat Types and Associated Animals: Unocal Treatment Plant

Eight habitat types were identified on the Unocal site (Figure 7-2): (1) developed areas; (2) upland forest; (3) upland shrub; (4) forested/scrub-shrub wetland and riparian; (5) emergent wetland; (6) open water wetland; (7) saltwater marsh (estuary); and (8) marine nearshore. These habitat types are also summarized in Table 7-11. Habitats and associated wildlife species are described in more detail in Appendix 7-C, Unocal Site Sensitive Areas Technical Report.

Special Status Species: Unocal Treatment Plant

No special status plant species are documented on or near the Unocal site. Among federally listed wildlife species, bald eagle and marbled murrelet occur within the Unocal site vicinity. Bald eagle nests are located approximately 0.5 mile south and 1.5 miles north of the site. Bull trout habitat is limited immediately on and off the site, while bald eagle foraging and potential nesting habitats are found on the Unocal site. There is no identified marbled murrelet habitat on the site, although murrelets generally feed within 1.2 miles of the marine shoreline. The presence of listed marine species is discussed in the Unocal Outfall section below. Coho and chinook salmon are discussed in the following fish resources section.

Several other special status species may occur on the site. Of these, signs of pileated woodpecker foraging are present in forested habitats on the site. Purple martin nest boxes were installed in 2001near Deer Creek, approximately 1 mile south of the site, and purple martins have been observed using this area (Tirhi, personal communication, 2002). A

great blue heron rookery was active in the site vicinity for 2 years, but no active nests or adult birds were observed in 2002 (Brookshire, personal communication, 2002).

A comprehensive list and description of special status species that may occur on or in the vicinity of the Unocal site is included in Appendix 7-C, Unocal Site Sensitive Areas Technical Report.

Table 7-11. Habitat Types on the Unocal Site

Habitat Type	Description	Area	Location on Site
Developed areas	Former tank sites (gravelly areas), office buildings, a gravel lot in the lower yard, Marina Beach Park	28 acres	Central
Upland forest	Dominant trees and shrubs include big leaf maple, red alder, western red cedar, Douglas fir, Indian plum, hazelnut, red elderberry, salmonberry, Himalayan blackberry	15 acres	Steep slopes above Puget Sound, and between former tank sites and fish hatchery
Upland shrub	Dominated by non-native Scot's broom	2.6 acres	Between Puget Sound shoreline and forested slope and on berm between Wetlands A and B
Forested/scrub-shrub wetland and riparian	Dominated by red alder, Scouler's willow, black cottonwood, salmonberry, Douglas spiraea, skunk cabbage	3.3 acres	Within the northeast site boundary, in Wetlands A and B
Emergent wetland	Dominated by cattail, bentgrass, purple loosestrife (a noxious weed), and American three-square	1 acre	Within the northeast site boundary, in Wetland B
Open water wetland	Open water portion of Wetland B, lined by cattails and other emergent plants	0.12 acre	In Wetland B
Saltwater marsh	Tidally influenced and dominated by American three-square, fleshy jaumea, Pacific silverweed, and saltgrass	1 acre	In Wetland A
Marine nearshore	Macroalgae, primarily *Ulva* and *Entermorpha*, prevalent in large patches along the Unocal pier, eelgrass beds are small and sparse	2 acres	Puget Sound shoreline, west portion of site

Wetlands: Unocal Treatment Plant

Three wetlands were identified on the Unocal site: Wetland A (Edmonds Marsh); Wetland B (a stormwater detention pond); and Wetland C (a side slope seep wetland). Most of Edmonds Marsh is located outside of the site boundaries. Wetland B is composed of a detention pond separated from the Edmonds Marsh by a human-made berm. Wetland C is located on the hillslope above the existing Unocal offices. Wetland descriptions, classifications, ratings, and buffers are summarized in Table 7-12. Offsite wetlands not expected to be affected by the project are not included in this table. These wetlands are discussed in the Draft EIS.

Fish Resources: Unocal Treatment Plant

Two streams, Willow Creek and Shelleberger Creek, are located on and adjacent to the Unocal site. Each of these streams support coho salmon, chum salmon, cutthroat trout, stickleback, and sculpin. Prior to the installation of the tidegate at the mouth of Willow Creek, the stream also supported use by adult chinook salmon as a result of accidental releases from the Deer Creek Hatchery (Figure 7-2). Although access to chinook has been reopened since 1988 when the tidegate was reopened (FHWA et al., 1985), the stream is too small and lacks spawning substrates for chinook.

The current run of coho salmon is supported by accidental releases from the hatchery and the adult coho returns from a net pen project at the Edmonds Fishing Pier. Spawning opportunities in Willow Creek and Shelleberger Creek are limited because of culverts, beaver dams (Willow Creek), and unsuitable spawning substrate. Lower reaches of both streams are located within Edmonds Marsh and are tidally influenced. Substrates are silts, sand, and muck. Habitat in Willow Creek upstream of Pine Street is primarily riffle habitat with limited pools. This reach of Willow Creek may provide some rearing and spawning habitat for fish; however, the culvert under Pine Street may not be passable by fish (CH2M HILL, 1998).

Table 7-12. Wetland Descriptions and Classifications for the Unocal Site

Wetland	Wetland Size (Acres)	Hydro-Geomorphic (HGM) Classification	Associated Streams	USFWS (Cowardin) Class[a]	Ecology Rating[b] (Category)	City of Edmonds Rating	City of Edmonds Buffer (ft)	Vegetation (dominant species)	Mapped Soil Type[c]	Observed Soil Type
A	2.85 onsite only	Depressional outflow	Willow Creek, Shelleberger Creek	EEM, PEM, PSS, PFO	I	1	100	American three-square, fleshy jaumea, Pacific silverweed, saltgrass, cattail, red alder, Scouler's willow, black cottonwood, salmonberry	Mukilteo muck, Alderwood and Everett gravelly sandy loam	muck, silt loam
B	2.3	Depressional outflow	Outlets to Willow Creek	POW, PEM, PSS	III	3	25	Cattail, bentgrass, purple loostrife, American three-square, willow, Douglas spiraea	Urban Land 1 Soils	sandy loam containing construction debris
C	0.02	Slope		PSS	III	3	25	Salmonberry, giant horsetail, Watson's willow herb, Himalayan blackberry	Alderwood gravelly sandy loam	silty clay

[a] U.S. Fish and Wildlife Service wetland classifications: EEM-Estuarine Emergent, PEM-Palustrine Emergent, POW – Palustrine Open Water, PSS-Palustrine Scrub Shrub, PFO-Palustrine Forest (Cowardin et. al., 1985)
[b] Ecology (1993).
[c] Debose and Klungland, 1983).

Deer Creek Hatchery

The Deer Creek Hatchery on Willow Creek produces approximately 120,000 juvenile coho salmonids per year. Coho raised at the Deer Creek Hatchery are released into North Creek and Swamp Creek, tributaries to the Sammamish River in Lake Washington. There are no intentional releases to Willow Creek, although approximately 4 to 5 percent of the juvenile coho that were raised at the hatchery have accidentally escaped each year and entered into Willow Creek from the pond through the overflow pipe (Thompson, personal communication, 2002). Additional information on the Deer Creek Hatchery is located in Appendix 7-C, Unocal Site Sensitive Areas Technical Report.

7.2.3.2 Conveyance Affected Environment: Unocal

The Unocal corridor consists of an influent pipeline to carry wastewater from existing King County pipelines in Bothell and Kenmore to the Unocal treatment plant site. Streams on or adjacent to candidate portal sites associated with the influent corridor include an unnamed tributary to the Sammamish River, Horse Creek, Sammamish River, McAleer Creek, and Lyon Creek. Most of the wetlands potentially affected are located in riparian areas of these streams and include forested, scrub-shrub, and emergent vegetation communities.

Four primary portals (Portals 14, 11, 7, and 3) are proposed for the Unocal corridor. Four secondary portals (Portals 13, 12, 10, and 5) are also proposed for this corridor. Tables 7-13 and 7-14 provide summaries of aquatic resources located on primary and secondary candidate portal sites in portal siting areas.

Table 7-13. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Candidate Primary Portal Sites on the Unocal Corridor

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS (Cowardin) Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
14	A	52a	Stream	R2SB	–	–	City of Bothell	2
		52b	Stream	R2SB	–	–	City of Bothell	2
		52	Wetland	PFO, PSS, PEM	Riverine	2	City of Bothell	1
	B	52a	Stream	R2SB	–	–	City of Bothell	2
	D	151	Wetland	PEM	Depressional	4	City of Bothell	3
3	–	None identified	–	–	–	–	–	–
11	See Table 7-6.							
7	See Table 7-7.							

[a]Figures 7-3 through 7-23 depict aquatic resource [AR] identification and aerial photographs for each portal siting area.
[b]Candidate portal sites are a minimum of 1 acre each. Figures 7-3 through 7-23 depict AR identification and aerial photographs for each candidate portal site.
[c] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.
[d] U.S. Fish and Wildlife Service classifications describe the dominant vegetation structure in the wetland. Major groupings are palustrine [freshwater wetland (PFO = forested, PSS = scrub-shrub, PEM = emergent, POW = open water)]; riverine [stream or river (R2SB = lower perennial, R3SB = upper perennial, R4SB = intermittent, R2UB = unconsolidated bottom)]; estuarine [coastal wetlands with saltwater and tidal influences (E2EM = intertidal emergent)]; and lacustrine [lakes (L1OW = limnetic {deep} open water, L2OW = littoral {shallow} open water)]. (Cowardin et al. 1985).
[e]HGM classifications describe the position in the landscape occupied by the wetlands. Major groups include *depressional* = occupying a geographic depression; *riverine* = associated with a stream or river; *lacustrine* = associated with a lake; *estuarine* = under tidal influence*;* and *sloped* = hillside seeps (Brinson, 1993).
[f]These ratings were developed by the Washington State Department of Ecology based on functional attributes that wetlands provide. Class 1 wetlands have highly valued functions, whereas Class 3 wetlands provide minimal functional value (Ecology, 1993). These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.
[g]Local ratings are based on applicable city, town, and county regulations, which were developed in a manner similar to the Ecology ratings. Details on the underlying rationale for and implications of these ratings can be found in Appendix 7-A, Affected Environment: Plants and Animals. These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.

Table 7-14. Classifications, Ratings, and Local Jurisdictions for Aquatic Resources on or Adjacent to Unocal Corridor Candidate Secondary Portal Sites

Portal Siting Area[a]	Candidate Portal Site[b]	Aquatic Resource Number[c]	Name or Type	USFWS (Cowardin) Classification[d]	Hydro-Geomorphic (HGM) Wetland Classification[e]	Preliminary Ecology Wetland Rating[f]	Local Jurisdiction	Preliminary Local Rating[g]
13	A	62	Horse Creek	R2SB	–	–	City of Bothell	2
		63	Sammamish River	R2UB	–	–	City of Bothell	1
	B	63	Sammamish River	R2UB	–	–	City of Bothell	1
	C	–	None identified	–	–	–	–	–
12	C and E	129	Wetland	PEM, PSS	Riverine	1	City of Kenmore	1
10	A	72	Lyon Creek	R2SB	–	–	City of Lake Forest Park	no rating
	C	81	McAleer Creek	R2SB	–	–	City of Lake Forest Park	no rating
		152	Wetland	PFO	Riverine	3	City of Lake Forest Park	3
	D	72	Lyon Creek	R2SB	–	–	City of Lake Forest Park	no rating
	E	153	Wetland	PEM	Depressional	4	City of Lake Forest Park	3
5	See Table 7-6.							

[a]Figures 7-3 through 7-23 depict aquatic resource [AR] identification and aerial photographs for each portal siting area.
[b]Candidate portal sites are a minimum of 1 acre each. Figures 7-3 through 7-23 depict AR identification and aerial photographs for each candidate portal site.
[c] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.
[d] U.S. Fish and Wildlife Service classifications describe the dominant vegetation structure in the wetland. Major groupings are palustrine [freshwater wetland (PFO = forested, PSS = scrub-shrub, PEM = emergent, POW = open water)]; riverine [stream or river (R2SB = lower perennial, R3SB = upper perennial, R4SB = intermittent, R2UB = unconsolidated bottom)]; estuarine [coastal wetlands with saltwater and tidal influences (E2EM = intertidal emergent)]; and lacustrine [lakes (L1OW = limnetic {deep} open water, L2OW = littoral {shallow} open water)]. (Cowardin et al. 1985).
[e]HGM classifications describe the position in the landscape occupied by the wetlands. Major groups include *depressional* = occupying a geographic depression; *riverine* = associated with a stream or river; *lacustrine* = associated with a lake; *estuarine* = under tidal influence*;* and *sloped* = hillside seeps (Brinson, 1993).
[f]These ratings were developed by the Washington State Department of Ecology based on functional attributes that wetlands provide. Class 1 wetlands have highly valued functions, whereas Class 3 wetlands provide minimal functional value (Ecology, 1993). These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.
[g]Local ratings are based on applicable city, town, and county regulations, which were developed in a manner similar to the Ecology ratings. Details on the underlying rationale for and implications of these ratings can be found in Appendix 7-A, Affected Environment: Plants and Animals. These ratings are based on current information and preliminary investigation of the candidate portal sites and could change in the future.

7.2.3.3 Outfall Affected Environment: Unocal

The shoreline in the vicinity of outfall Zone 6 consists of low bank bluffs with deciduous trees in southern portions of the zone. Zone 6 extends west from a City of Edmonds park that includes primarily grass and asphalt parking. An existing, non-operational pier is located at the southern boundary of Zone 6.

The upper intertidal zone in Zone 6 consists mainly of sand with some larger cobbles and boulders in the southern portion of the zone. The northern portion of the zone along with an area south of the Unocal pier contains large woody debris in the form of driftwood. The upper intertidal area has been modified in the northern portion of this zone by the seawall bordering the southern end of the Edmonds Marina.

The extensive characterization of the nearshore vegetated habitat in the southern portion of Zone 6 found eelgrass to be sparse and patchy (Figure 7-24) (Woodruff et al., 2001). No kelp was observed during the survey (Woodruff et al., 2001). An eelgrass survey along the preferred alignment for the Unocal outfall completed in 2003 to assess eelgrass distribution and abundance in the area not previously surveyed due to sampling constraints (Appendix 7-F, Eelgrass Survey Results for the Brightwater Marine Outfall Alternatives) found an eelgrass bed in shallow water running parallel to the shoreline. The bed ranged in width from 40 to 140 feet (onshore to offshore) and had an average density of 108 shoots/m^2 (Figure 7-27). There was no eelgrass observed below approximately -1.0 feet MLLW.

Sea lettuce is found along most of the shoreline south of the Unocal pier in moderate to dense amounts (Woodruff et al., 2001). While the northern portion of Zone 6 was not included in this habitat survey because of sampling logistics, sea lettuce was found to be present in this area during an earlier survey conducted by Pentec (1995). The 2003 survey in the proposed outfall alignment area found no sea lettuce in the upper intertidal area but found this species to dominate the area between +1.0 to -1.0 MLLW, particularly between +1.0 to +0.3 MLLW (Parametrix and King County, 2003). As with the previous survey (Pentec, 1995), no kelp was observed.

Nearshore sediments in Zone 6 are composed mainly of sand with some mixed cobble and gravel substrate in the intertidal area in the southern portion of the zone (Woodruff et al., 2001). Bottom sediments in the deep subtidal zone of Zone 6 are comprised of 81 to 82 percent sand and silt (King County, 2002a). Substrate north of the proposed alignment consists primarily of gravel from +2.0 to +1.0 MLLW, with occasional small boulders. South of the proposed alignment, the substrate consists of a combination of sand (10 to 80 percent) and gravel (25 to 80 percent). Below +1.0 MLLW, the substrate transitions predominately to sand (Parametrix and King County, 2003).

Similar to Zone 7S, a wide variety of organisms are found in and near Zone 6 (Table 7-15).

Table 7-15. Animals Observed in or Near Outfall Zone 6

Species	Habitat area observed	Reference
Fish		
Chum, pink, chinook salmon *	Intertidal/shallow subtidal	Taylor Assoc. 2002
Shiner perch	Intertidal/shallow subtidal	Taylor Assoc. 2002
Surf perch	Intertidal/shallow subtidal	Woodruff et al. 2001
English sole	Intertidal/shallow subtidal	Taylor Assoc. 2002
Starry flounder	Intertidal/shallow subtidal	Taylor Assoc. 2002
Buffalo, great sculpin	Intertidal/shallow subtidal	Taylor Assoc. 2002
Sand lance	Intertidal/shallow subtidal	Taylor Assoc. 2002
Crescent gunnel	Intertidal/shallow subtidal	Taylor Assoc. 2002
Tubesnout	Intertidal/shallow subtidal	King County 2002c
Ratfish	Intertidal/shallow subtidal	Woodruff et al. 2001
Macroinvertebrates		
Geoduck clam *	Intertidal/shallow subtidal	Golder and Parametrix 2002
Horse clam	Intertidal/shallow subtidal	Golder and Parametrix 2002
Sea cucumber	Intertidal/shallow subtidal	Woodruff et al. 2001
Various anemones	Intertidal/shallow subtidal	Woodruff et al. 2001
Sea pen	Intertidal/shallow subtidal	Woodruff et al. 2001
Dungeness crab *	Intertidal/shallow subtidal	Woodruff et al. 2001
Various sea stars *	Intertidal/shallow subtidal	Woodruff et al. 2001
Marine Mammals *		
Killer (orca) whale	Deep subtidal	Striplin et al., 2001
Gray whale	Deep subtidal	King County 2001
Dall's porpoise	Deep subtidal	King County 2001
Steller sea lion	Deep subtidal	Striplin et al., 2001
Harbor seal	Deep subtidal	King County 2001
California sea lion	Deep subtidal	King County 2001

Table 7-15. Animals Observed in or Near Outfall Zone 6 (cont.)

Species	Habitat area observed	Reference
Birds *		
common murre	Deep subtidal	Striplin et al., 2001
marbled murrelet	Intertidal/shallow subtidal	Striplin et al., 2001
harlequin duck	Intertidal/shallow subtidal	Striplin et al., 2001
red-necked grebe	N/A	PAS 2003
horned grebe	N/A	PAS 2003
western grebe	N/A	PAS 2002
double-crested cormorant	N/A	PAS 2003
surf scoter	N/A	PAS 2003
white-winged scoter	N/A	PAS 2002
black scoter	N/A	PAS 2002
common goldeneye	N/A	PAS 2003
bufflehead	N/A	PAS 2003
dunlin	N/A	PAS 2003
glaucous-winged gull	N/A	PAS 2003
mew gull	N/A	PAS 2002
pigeon guillemot	N/A	PAS 2003
rhinoceros auklet	N/A	PAS 2003

* Indicates that while the species was observed in this habitat area, it may also occur in other areas of the outfall zone.
N/A = Information not available.
PAS = Pilchuck Audubon Society

7.3 Impacts and Mitigation

This evaluation characterizes the potential impacts to plants, animals, and wetlands on the alternative treatment plant sites, along the conveyance corridors and on candidate portal sites, and in outfall zones. Impacts associated with construction are described, followed by discussion of long-term impacts associated with operation of the Brightwater System.

7.3.1 Impacts and Mitigation Common to All Systems

Construction impacts and mitigation common to the alternative treatment plant sites, conveyance corridors, and alternative outfall zones are discussed in the following sections.

7.3.1.1 Treatment Plant Impacts and Mitigation Common to All Systems

General impacts to plants, animals, and wetlands that are common to all construction-related activities at the alternative treatment plant sites are discussed below. Construction activities are estimated to last up to 4.5 years (approximately), with major earthwork occurring for up to 2.5 years (within the 4.5-year duration).

Construction Impacts Common to All Systems: Treatment Plant

Construction impacts at the alternative treatment plant sites include the potential for habitat loss and fragmentation; erosion and sedimentation; accidental discharges of pollutants; dewatering impacts; and increased noise, lighting, and human activity. Direct and indirect impacts are discussed.

Habitat Loss and Fragmentation

Habitat loss would occur at both treatment plant sites. Habitat loss and fragmentation would generally result in the loss of cover, nest sites, foraging areas, and corridors for wildlife movement. Mortality of individual animals, especially ground-dwelling species such as mountain beaver and vole, is also likely to occur during construction.

A small amount of wetland and wetland/stream buffer loss is anticipated at both sites. Depending on the quality of the wetlands, the loss of wetlands and vegetated buffer areas can affect important functions such as shading/water temperature control, provision of woody debris, water quality improvement, erosion control, and foraging, water source, and refuge for wetland- and stream-dependent wildlife species.

The treatment plant sites would be constructed primarily along existing rights-of-way; impacts to habitat are anticipated to be minimal.

Erosion and Sedimentation

Excavating, grading, stockpiling, and transporting of soils during construction can cause increased turbidity (suspended sediments) and sedimentation in adjacent streams or wetlands by wind or water erosion. However, best management practices (BMPs), including site erosion control measures, would be designed to prevent construction-related sediments from reaching sensitive habitats (see Chapter 6 and Appendix 6-C, Management of Water Quality During Construction at the Treatment Plant Sites).

Increased sedimentation and turbidity in surface waters can cause the mortality of aquatic-dwelling species, loss of eggs or young, behavioral changes, or a reduction in available forage. Animals that forage on aquatic species may also be affected. Stormwater management for the project would comply with state Water Quality Standards for turbidity levels, as described in Appendix 6-C, Management of Water Quality During Construction at the Treatment Plant Sites.

The extent to which suspended sediments from construction of Brightwater may adversely impact resident and migratory fish that may be present in affected streams depends on many factors including background turbidity, amount of increase in turbidity, and duration of increased turbidity (NMFS, 2000). Studies have shown that juvenile salmon avoid water when turbidity levels are high (Bisson and Bilby, 1982 *in* NMFS, 2000; Waters, 1995). Bisson and Bilby (1982 *in* NMFS, 2000) found that the avoidance threshold for coho was 70 nephelometric turbidity units (NTU). Migrating fish will avoid areas of high suspended sediments, resulting in a disruption of their migration and a subsequent reduction of reproductive success (Waters, 1995). Sedimentation can reduce the quantity and quality of fish spawning habitat, reduce the quality of pool and riffle habitats, and lead to an overall decrease in habitat complexity. These effects of sedimentation can lower the carrying capacity of the affected stream and can result in lower numbers of fish in the stream system.

Accidental and Incidental Discharge of Pollutants

Use of construction equipment can result in the incidental, incremental, or accidental discharge of pollutants such as fuel, oil, grease, and hydraulic fluid. These pollutants may be discharged into adjacent aquatic habitats during regular construction activities or in the event of machinery failure. Implementation of BMPs would prevent or reduce the probability of accidental spills. More information about the potential for spills and leaks is provided in Chapter 9, Environmental Health.

The effects of pollutant discharge on plants, animals, and wetlands on alternative Brightwater treatment plant sites would depend on the volume, type of substance released, and the cleanup response. Employment of spill kits for cleanup immediately after an accidental spill would reduce the effect of the spill on the surrounding environment. Heavy substances (like grease), however, are likely to persist in aquatic systems unless they are removed. These substances have a high potential for toxicity to

resident fish and aquatic organisms. Lighter petroleum products are toxic when their concentrations reach certain thresholds. Large accidental releases of pollutants can cause direct mortality or impair the health of fish, amphibians, and other aquatic biota.

Removal and Discharge of Dewatering Water

To facilitate construction of the treatment plant, groundwater would need to be removed from the work zone to enable construction activities to occur below grade. The amount of groundwater removed would vary depending on the depth of excavation, and the presence or absence of shallow unconfined aquifers, deep confined aquifers, or bedrock. Appendix 6-B, Geology and Groundwater, describes dewatering requirements and related mitigation measures.

Dewatering during construction of the Brightwater treatment plant could potentially temporarily lower groundwater elevations and divert water that feeds streams or wetlands, lowering the water levels within these water bodies. Any significant lowering of water levels in nearby wetlands and streams would affect plants and animals in these systems, potentially causing mortality or stress. Small streams would be most susceptible to this potential impact, particularly during summer low-flow conditions when streamflows may become low enough to strand fish in remaining small pools. Streamflow alterations can also affect active fish nests (redds) or juveniles by affecting in-gravel flows, temperatures, and in-gravel dissolved oxygen concentrations, or by dewatering of gravels and redds.

Flows artificially increased by dewatering could affect fish behavior during spawning. For example, salmon attracted by these flows may create nests in areas that are not normally flooded or may otherwise be unsuitable for spawning. Groundwater discharges in the late summer and early fall could mimic fall freshets that are known to trigger salmon to begin their migration and could prematurely draw spawning salmon into tributary streams that receive dewatering water for extended periods. If flows maintained by dewatering cease prior to fall freshets, redds may become exposed and susceptible to dessication, resulting in subsequent death of fish eggs.

The sediment, nutrient, pH, and oxygen levels in discharged water may also change conditions in the receiving aquatic systems. At the Route 9 site, groundwater could be aerated to raise dissolved oxygen levels before discharge to Little Bear Creek. Aeration would occur at the Unocal site as well, if necessary.

If dewatering water is discharged directly into neighboring wetlands or streams, water levels in these systems could potentially be altered. If unmitigated, large volumes of dewatered groundwater may alter in-stream habitat if these large influxes of discharge water are of long enough duration or if they occur during certain periods of the year, such as during fish spawning periods. Small streams are likely to be affected more by these changes than larger volume streams. However, no discharges would exceed 10 percent of the receiving streams flow, as recommended by Ecology guidelines, unless a study verifies that additional discharge would not impact the water quality, channel morphology, or aquatic biota of the stream (see Appendix 6-C, Management of Water

Quality During Construction at the Treatment Plant Sites). Under these conditions, no significant adverse impacts to receiving streams or wetlands are anticipated.

Increased Noise, Lighting, and Human Activity

During construction, vehicular and human traffic would increase on the treatment plant sites and in the surrounding areas. Construction equipment and human activity would generate increased noise levels in the immediate surrounding area of the construction site.

Noise levels associated with construction could reach up to 90 dBA at 50 feet for both sites and up to 101 dBA at 50 feet if impact pile driving were used (see Chapter 10). Vibratory pile driving would reduce these noise impacts. This noise may affect wildlife using habitats in the vicinity of the construction area. Studies have shown that certain wildlife species respond negatively to noise from sources such as aircraft overflights, military operations, recreational activities, and automobile traffic (Larkin, 1995; Radle, undated). Noise from these activities can affect wildlife activity and communication patterns, including predator-prey relationships and reproductive success. Noise from heavy machinery and equipment also may affect wildlife physiology and behavior in a similar manner. Birds may not be able to hear each other singing, which may disrupt territorial behavior. Male frogs and toads have been shown to alter their breeding calls and space themselves differently near noisy highways compared to those living in quieter areas away from highways (Larkin, 1995). The distribution and behavior of juvenile salmonids appear to be affected by pile driving, with fish moving away from pile driving noises at Everett Homeport (Feist et al., 1992). Wildlife species not accustomed to human-generated noise are likely to be less tolerant of increased noise and activity. These species may avoid habitat areas near construction areas or experience other behavioral responses.

Night lighting during construction may be required to meet construction schedules and to light areas of high traffic at construction sites. Although night lighting during construction is expected to be minimal and to be directed downward to the specific areas, lighting can affect animal behavior by attracting insects and species that prey upon these insects. Night lighting can disrupt the movements of amphibians, birds, and fish, negatively affecting some species and potentially altering predator-prey relationships.

Operation Impacts Common to All Systems: Treatment Plant

Both treatment plant sites are located near sensitive habitat areas and species that could be affected by treatment plant operations. Effects may result from stormwater runoff or from increased noise, lighting, and human activity. These effects are discussed below.

Stormwater Treatment

Stormwater treatment facilities operating at both sites would be designed to attenuate peak flows from impervious surfaces and to protect adjacent surface waters from pollutants generated at the sites. A main goal of the stormwater treatment facilities is to

protect adjacent sensitive habitats or species from highly fluctuating flows and pollution normally associated with stormwater. The stormwater facilities would also be designed to prevent stormwater from areas with the potential for chemical spills and leaks from reaching adjacent wetlands and streams. A significant discharge of a chemical such as sodium bisulfite to a stream could be lethal to fish by reducing dissolved oxygen levels. However, such spills are unlikely with implementation of proposed mitigation measures.

A decentralized stormwater system, along with numerous low-impact development features, would be used at the Route 9 site, while a more centralized system would be used at the Unocal site. Both treatment systems would be designed to meet or exceed state Water Quality Standards intended to protect beneficial uses of surface waters, including aquatic habitat. These systems are described in Chapter 6 and in Appendix 6-D, Permanent Stormwater Management at the Treatment Plant Sites.

Increased Noise, Lighting, and Human Activity

Operational activities on the proposed treatment plant sites would contribute to increased noise levels. Operations noise may reduce the numbers of noise-sensitive animals that currently use habitats near the treatment plant sites. Nighttime noise levels will increase because the wastewater facilities would operate 24 hours per day. The potential effects of noise and lighting on wildlife are previously described under the construction impacts section above.

Proposed Mitigation Common to All Systems: Treatment Plant

The overall approach to mitigation for the treatment plant sites would be to first avoid impacts to sensitive habitat areas to the extent possible through careful site design, planning, construction techniques, and strict adherence to BMPs. If impacts cannot be avoided, then various mitigation measures would be implemented.

Specific mitigation measures would be implemented pursuant to federal, state, and local permit conditions and regulations. The design and construction of the Brightwater project will adhere to federal, state, and local sensitive area regulations and will follow required mitigation measures and the mitigation sequence developed by the U.S. Army Corps of Engineers (COE) for the waters of the United States and as defined in WAC 173-26-020:

- Avoid impacts to wetland, stream, and wildlife habitats and their associated species
- Minimize impacts, if avoidance is not possible
- Rectify and restore areas where possible
- Reduce the adverse impacts by preservation and maintenance operations
- Provide compensatory mitigation (i.e., replacement of lost wetlands)
- Monitor the impacts and mitigation and take appropriate corrective measures

General Construction Mitigation Measures

The following provides a list of general mitigation measures that would be implemented to prevent or minimize impacts to plants, animals, and wetlands on the selected treatment plant site during construction:

- Clearly identify construction boundaries to avoid encroachment into adjacent habitat areas.
- Minimize clearing of vegetation and protect vegetation remaining onsite from damage during construction.
- Comply with erosion BMPs as described in Chapter 4, and employ a stormwater pollution prevention plan that would prevent or minimize sedimentation of on- and offsite water bodies.
- Minimize night lighting during construction and operations, especially in stream and wetland habitats.
- Utilize vibratory pile driving instead of impact pile driving where feasible.
- Implement a site specific dewatering plan, developed during predesign and permitting phases, to minimize impacts during dewatering activities (see Chapters 4 and 6 and Appendix 6-B, Geology and Groundwater, for more details regarding dewatering).
- Prepare and follow a Spill Prevention, Containment, and Control Plan for site construction, as described in Chapter 9.
- Schedule construction within work windows specified by WDFW, COE, NOAA Fisheries, and/or USFWS to avoid critical periods (i.e., nesting and breeding/spawning, migration) for wildlife and fish. Confine in-stream work, where unavoidable, to the period designated by WDFW when salmonids are least likely to be present in the system.
- Perform tunnel boring at adequate depths below surface waters to avoid or minimize the opportunity of slurry materials reaching surface waters, as described in Chapter 6.
- Minimize vegetation removal to the extent possible on each site to reduce the loss of wildlife habitat and movement corridors. Mitigation for the removal of upland habitat including forested habitat is addressed in the sections covering individual treatment plant sites.
- Section 7 of the Endangered Species Act (ESA) would require consultation with NOAA Fisheries and/or USFWS and preparation of a biological assessment regarding potential impacts to federally endangered and threatened species. King County will comply with any requirements imposed by NOAA Fisheries and/or USFWS regarding federal special status species.

- If nests of state-protected special status species (such as great blue heron rookeries) are reported on or near the site, WDFW recommendations will be followed to protect the nest site during the breeding season. Impacts to habitats that support special status species would be avoided and minimized to the extent possible at either potential treatment plant site.

Wetlands and Fish Habitat Construction Mitigation

- Work in aquatic habitats would be minimized to the extent possible. Potential mitigation measures for protecting wetlands and fish habitat include avoiding work in aquatic habitats and avoiding sediment transport to aquatic habitats and their buffers. Potential mitigation measures for in-water work would include the removal and salvage of fish from the project area to undisturbed upstream or downstream habitat if they are present during construction.
- Mitigation for wetland impacts would be implemented in accordance with local, state, and federal regulations. The COE would require an Individual 404 Permit for the Brightwater project, which would be permitted as a system including plant sites, conveyance, and outfall. The COE requires mitigation for impacts to streams and wetlands on a case-by-case basis.
- At the state level, King County will work with WDFW and Ecology to meet all applicable permitting requirements. WDFW requires a Hydraulic Project Approval (HPA) for certain modifications to salt waters or fresh waters and their beds. WDFW typically issues the HPA on the condition that approved mitigation measures, determined on a case-by-case basis, and BMPs will be implemented during and after construction of the project.
- Ecology reviews projects pursuant to Section 401 of the federal Clean Water Act (Water Quality Certification) to determine if there is reasonable assurance that the state Water Quality Standards will be met. Ecology may condition the certification with requirements that must be met. Ecology also provides guidance on wetland classifications and suggests replacement ratios for impacts to wetlands. The Section 401 certification is issued before the Section 404 permit is issued.
- King County will also meet applicable local permit requirements for critical areas. Local jurisdictions require protection of wetlands, streams, and fish habitat through establishment of upland buffers surrounding these areas. They also require replacement ratios for impacts to wetlands and their buffers and mitigation measures for impacts to streams and their buffers and for some fish and wildlife species. Because the local regulations are specific to each plant site, these are described in more detail for each alternative later in this chapter.

Operation Mitigation

- Low impact development (LID) practices would be used to minimize the impacts of operations, including impacts from impervious surfaces. LID measures likely

to be used include minimizing the building, parking, and roadway footprints; using permeable materials for roads and parking areas; collecting roof runoff and providing areas for re-infiltration; amending soil in landscaped areas; landscaping with native plants; and incorporating vegetated roofs into treatment plant design where practicable.

- The Brightwater System would be designed to prevent overflows to upland, wetland, or stream habitats in the vicinity of the treatment plant.
- Potential for accidental and incidental discharge of pollutants, such as petroleum products, during operation of the plant is minimal. Ongoing implementation of BMPs and adherence to a Spill Prevention, Containment, and Control Plan would avoid accidental discharges. During treatment plant operation, spill prevention measures such as leak detection systems, secondary containment, drainage retention, and regular inspection and maintenance will be developed consistent with the UFC and other applicable regulations. Storage tanks will be designed with double walls, spill containment berms, alarms, level indicators, ventilation, and other features to minimize spill risks and impacts.
- Night lighting would be directed only to developed treatment site areas, and operations noise would be restricted in accordance with Snohomish County or City of Edmonds noise control regulations.

7.3.1.2 Conveyance Impacts and Mitigation Common to All Systems

Construction Impacts Common to All Systems: Conveyance

Similar to the impacts described for construction of the treatment plant sites, potential construction impacts associated with conveyance corridors include erosion and sedimentation, temporary habitat loss or fragmentation (e.g., vegetation clearing and grading), accidental and incidental discharge of pollutants, dewatering and discharge of dewatering water, and increased noise and lighting levels. Impacts to surface waters due to sedimentation and dewatering (including estimated dewatering volumes) are further discussed in Chapter 6. Direct impacts to sensitive areas outside of portals are anticipated to be minimal during construction of the corridors, which may take up to 4 years, because the tunnel depth would be well below sensitive areas located along the conveyance corridors. Impacts would, however, be possible at portal sites. Sensitive areas identified on these sites include wetlands, streams, associated buffers, and mature forest (Tables 7-6 through 7-9, Table 7-13, and Table 7-14).

For each portal siting area, between two and six candidate portal sites have been identified for further analysis. Avoidance of sensitive areas was a factor considered during the evaluation of candidate portal sites and will be an important factor in selecting a preferred candidate site after the Final EIS is completed. Avoidance of sensitive areas was further considered when the construction footprint was designated for each of the

portal sites. The size of the construction footprint depends on whether the portal is designated as a primary portal (launching or recovery portal) or secondary portal and on the facilities that would be constructed at the portal. In addition, secondary portals may not be needed at all. This will be determined during final design.

Figures 7-3 through 7-23 present wetlands, streams, buffers, and mature upland forest on or directly adjacent to candidate portal sites for each portal siting area. During construction, primary portal sites where the tunnel boring machine would be recovered would require a minimum of 1 acre; sites where the tunnel boring machine would be launched would require a minimum of 2 acres. Secondary portals, if used, would disturb up to 0.5 acre and would be used for temporary ventilation shafts, deep ground improvement, and/or supply of backfill grout. See Chapter 3 for more detail.

Boundaries of wetlands, streams, and mature upland forest shown for candidate portal sites are approximate due to limited site access. Therefore, calculated impacts are also approximate. Portal and facility footprints were located in disturbed uplands to the maximum extent feasible; space was also allowed for site access. Impacts are estimated for wetlands, streams, their buffers, or mature forest where insufficient disturbed upland was available. After issuance of this Final EIS and selection of final portal sites in each portal siting area, formal wetland and stream delineations would be conducted to support permit applications. These reports would be used to calculate exact impacts and support the development of mitigation plans where appropriate.

Connection to the Existing Wastewater System

Microtunneling would be used to avoid impacts to wetlands, streams, and buffers near local sewer connections, which would range in length from 100 to 4,000 feet. For all of the alternatives, microtunneling is proposed for the Kenmore Pump Station connection and, if necessary, for the Kenmore local sewer connection at Portal 11. In addition, microtunneling is proposed for connection to the North Creek Pump Station at Portal 41 (Route 9 System) and Portal 14 (Unocal System). Excavation and backfilling associated with microtunnel pits have the potential to create erosion and sedimentation that could run off and enter nearby waterbodies, indirectly impacting streams, lakes, or wetlands. Such construction methods could also result in potential increases in indirect impacts to sensitive areas and the species that inhabit them related to potential spills, dewatering, and increased noise and lighting.

At Portal 44, a connection is proposed from the existing Swamp Creek trunk to the Route 9 influent corridor. During construction, an open trench would be excavated under existing roadways to make the connection. Open trenching would avoid direct displacement impacts to wetlands, streams, or buffers near the connection. Excavation and backfilling associated with open trenching has the potential to create erosion and sedimentation that could run off and enter nearby water bodies, indirectly impacting streams, lakes, or wetlands. Such construction methods could also result in potential increases in indirect impacts to sensitive areas and species inhabiting them related to potential spills, dewatering, and increased noise and lighting.

Vegetation Clearing and Grading

Vegetation clearing and grading on undeveloped or partially developed candidate portal sites proposed for Brightwater could adversely affect wildlife. Impacts associated with each proposed Brightwater System alternative are discussed later in this chapter. Where wetlands, buffers, and/or mature upland forest are displaced, local populations of wildlife species may not persist after portal construction. This may be the case if wildlife is not successful at dispersing to available refuges during construction, or are unsuccessful at recolonizing restored habitat after construction. However, any losses of local populations are not expected to jeopardize overall populations of any one particular wildlife species. These impacts would not occur at candidate portal sites that are already fully developed (in Portal Siting Areas 5, 11 and 41).

Undisturbed wetlands, buffers, and/or mature upland forest that could be displaced during construction of Brightwater conveyance facilities are typically associated with patches of habitat within an urban matrix. Disturbance could displace entire small patches of habitat, reduce the size of patches, or further fragment patches of habitat, each with potentially different effects on wildlife. Elimination of patch habitat could jeopardize the survival of individuals or small populations of wildlife species. For example, if the patch served as a refuge for birds during migration, birds may be able to colonize other similar habitat patches if these patches are not already at carrying capacity. If no alternative linkage for bird migration exists, the loss of such a link could cause increased stress or mortality to bird species. Reduction in the size of patch habitat or further fragmentation would stress the carrying capacity for wildlife and increase edge effects, including the adverse effects of invasive plant and animal species, pets, humans, light, and noise.

In areas that are currently poorly vegetated habitats, including paved or fully developed areas, the effects of habitat loss would be minimal because these sites are expected to support a low diversity of common urban species. The value of these poorly vegetated habitats as corridors for wildlife movement is minimal for terrestrial species; therefore, loss of additional vegetation would have minor effects on terrestrial species. However, loss of mature trees could affect bird species.

Impacted areas that are not required for long-term operation of the portals would be revegetated. The loss of shrub and tree habitat during construction would, however, take from 5 to 25 years to restore, resulting in a lag between the time when impacts occur and when habitat is restored. Once the vegetation has recovered to the point it resembles pre-construction conditions, the area would likely provide habitat functions similar to those now in place. Long-term effects on wildlife would be minimal if wildlife populations currently using the habitat are able to persist in the temporarily degraded condition, are able to disperse to available refuges during construction, or are able to recolonize the recovered habitat at current population levels. In other cases, some individual wildlife may perish.

The temporary removal of vegetation in riparian areas adjacent to fish-bearing streams could result in potential adverse impacts to fish. Riparian vegetation provides overhanging cover for fish, water quality improvement, large woody debris, shade and

water temperature regulation, and sources of nutrients such as terrestrial invertebrates or litter material. These functions may be lost or reduced due to the temporary elimination or reduction of riparian vegetation, particularly riparian forest. Over time, the loss of riparian forest area may alter in-stream channel habitat components, such as quality and quantity of pool habitat, substrate type, and channel type. The effects of vegetation loss would be greater on salmonids than for other resident and migratory fish species because of their greater sensitivity to temperature effects and habitat changes.

Some minor amounts of vegetation clearing may also be required for construction of transmission lines to serve portal facilities such as odor control facilities and pump stations. Impacts to upland habitat could occur during construction of these lines, which would be of varying lengths. As the form and location of specific energy facilities are determined in the design process, appropriate additional environmental review will be conducted as needed.

Removal and Discharge of Dewatering Water

Similar to the treatment plants, to facilitate construction of portal shafts and tunnels, groundwater would need to be removed from portal construction areas to enable construction activities to occur below grade. The amount of groundwater requiring removal would vary depending on the depth of the portal and the presence or absence of shallow unconfined aquifers, deep confined aquifers, or bedrock. Appendix 6-F, Groundwater and Stormwater Management at the Candidate Portal Sites, and Appendix 6-B, Geology and Groundwater, describe dewatering requirements and related mitigation measures for each portal siting area.

Groundwater inflow during construction of the primary portals would lower the groundwater elevation between 1 and 2 feet within a 500-foot radius for those portal sites constructed in saturated alluvium (see Chapter 6). If unmitigated in these areas, construction of primary portal sites associated with each of the conveyance alternatives would impact the hydrology of streams and/or wetlands. Flows in nearby streams could be reduced. The groundwater elevation in nearby saturated wetlands could be lowered enough to resemble upland hydrology, which could adversely affect the survival of wetland vegetation. Existing groundwater elevations would be restored after portal construction. Impacts at specific portals are discussed under each system alternative.

Similar to dewatering at treatment plant sites, if dewatering water from conveyance construction is discharged directly into neighboring wetlands or streams, water levels in these systems could potentially be altered. If unmitigated, large volumes of discharge water may alter in-stream habitat if these large influxes of discharge water are of long enough duration or if they occur during certain periods of the year, such as during fish spawning periods. Small streams are likely to be affected more by these changes than larger volume streams.

Flows artificially increased by dewatering for conveyance facilities could affect fish behavior during spawning. For example, salmon attracted by these flows may create redds in areas that are not normally flooded or may otherwise be unsuitable for spawning.

Groundwater discharges in the later summer and early fall could mimic fall freshets that are known to trigger salmon to begin their migration and could draw spawning salmon into tributary streams that receive dewatering water for extended periods. The sediment, nutrient, pH, and oxygen levels in the discharged water may also change conditions within the receiving aquatic systems.

No discharges are anticipated, however, that would exceed 10 percent of the flow in the receiving stream, as recommended by Ecology guidelines. Discharges that would exceed this recommendation may occur to Little Swamp Creek (Portal 44) and North Creek (Portal 41) during summer low flow periods if high dewatering discharge rates are encountered (see Chapter 6). Dewatering water would be discharged only at flows that exceed 10 percent of the flow in the stream if detailed hydrologic study verifies that additional discharge would not impact the water quality, channel morphology, or aquatic biota of the stream (see Appendix 6-C, Management of Water Quality During Construction at the Treatment Plant Sites). If a study shows that impacts would occur, water would be discharged to a local sanitary sewer system, or detained onsite to manage flow. Under these conditions, no significant impacts to receiving streams are anticipated. For portal construction, there would be no discharge of dewatering water to wetlands without prior treatment and detention.

Construction of Safety Relief Point

For both the Unocal and Route 9 conveyance alternatives, a safety relief point would be located in Kenmore near the existing Kenmore Pump Station east of Juanita Drive NE and south of NE Bothell Way. For the Unocal corridor and the influent portions of the Route 9 corridors, this safety relief point would discharge untreated wastewater into the Sammamish River in the unlikely event that power outages and large storm events cause overflows and after implementation of five flow management strategies that would be used to minimize the chance of overflows. The worst case probability of an overflow would be once every 100 years from 2010 to 2039 (Phase 1), increasing to once every 75 years from 2040 onwards (Phase 2). Refer to Appendix 3-E, Flow Management and Safety Relief Point.

Construction of the safety relief discharge point would require open cut construction for installation of a 72-inch diameter pipe that would connect at the existing Kenmore Interceptor directly south of NE Bothell Way and extend south to the Sammamish River. Patches of forested Sammamish River buffer and forested riparian wetlands occur along the River. If wetlands or vegetated buffers cannot be avoided, vegetation clearing and excavation in these areas would be necessary during construction.

Proposed Construction Mitigation Common to All Systems: Conveyance

- Similar to the mitigation measures described for construction of the treatment plant site, appropriate best management practices would be employed to avoid and minimize potential construction impacts, including erosion and

sedimentation, accidental and incidental discharge of pollutants, dewatering and discharge of dewatering water, and increased noise and lighting levels.

- Compliance with applicable federal, state, and local environmental regulations would mitigate for impacts to sensitive areas including wetlands, streams, buffers, and significant trees. If wetlands are permanently impacted, the appropriate compensatory mitigation ratios would be used to calculate the area of wetland creation, restoration, and/or enhancement necessary to mitigate for impacts. If buffers are impacted, mitigation is likely to include one or a combination of the following: (1) restoration of disturbed buffer, (2) enhancement of buffers that were reduced through buffer averaging, and (3) creation and enhancement of additional buffer area, to compensate for lost buffer area.
- Construction timing restrictions would avoid and minimize impacts to special status species present near construction sites (e.g., fish and bald eagle work windows).
- Mitigation measures at all candidate portal sites would include water quality treatment before the release of construction water to wetlands or streams. At those portal sites where construction dewatering would decrease the groundwater level in surrounding wetlands or decrease flows in streams, mitigation measures could include water quality treatment of dewatering water followed by release to surrounding wetlands and streams. Reintroducing dewatering water to surrounding wetlands would alleviate potential drought conditions during construction. The release of dewatering water to streams would be consistent with Ecology guidelines established to minimize and avoid instream impacts.
- Microtunneling will be used to avoid impacts to wetlands and streams during the construction of local connections.

Operation Impacts Common to All Systems: Conveyance

Compared to the treatment plants, operation impacts created by permanent structures at portal sites would be similar in nature (e.g., stormwater runoff, noise) but lesser in scale (e.g., less area) for both the Unocal and Route 9 corridors. Corridor-specific operation impacts are discussed later in this chapter. Similar to the impacts described for the treatment plant sites, potential operation impacts associated with portal structures include long-term habitat loss or fragmentation and increased stormwater runoff. After construction is complete, finished above-ground facilities at most of the primary portals would be limited to an access road, a 12-foot diameter manhole, space for landscaping and security, and an odor control or dechlorination facility . At other portals, the potential for impact would be greater. For the Unocal system alternative, a planned odor control facility along with a new pump station would be located at Portal 11. For the Route 9 system alternatives, an influent pump station and associated facilities would be located at Portal 41 (if constructed at the portal rather than at the treatment plant). These impacts are discussed in more detail under each system alternative.

Some portal sites may fall below the threshold amount of new impervious surface (5,000 square feet) that would require onsite stormwater facilities. In this case, untreated runoff from the developed portal facility could be directed to adjacent surface water bodies. Indirect impacts to flora and fauna from increased stormwater flow volumes would be similar to those described under treatment plant operation impacts common to all systems. Chapter 6 describes stormwater detention and treatment along the corridors.

Portal structures are not anticipated to result in increased noise levels during operation. Occasional vehicular noise associated with maintenance vehicles would not be expected to cause long-term disturbances to noise-sensitive species. Above-ground facilities at portal sites for dechlorination, tunnel access, odor control, and/or ventilation would be equipped with outdoor security lighting. Illumination from these facilities is expected to have minimal impact because the low-wattage lights would be used. Human activity at the portals is not expected to have any additional impacts compared to the current conditions.

Emergency Overflows at Safety Relief Point

As described in Chapter 3, all project conveyance alternatives would include a safety relief discharge point into the Sammamish River upstream from Lake Washington. The worst-case probability of an overflow at the safety relief discharge point is approximately once every 100 years from year 2010 to 2039 (Phase 1), increasing to once every 75 years from year 2040 and onwards (Phase 2). Releases to larger water bodies (such as the Sammamish River and Lake Washington) would increase dilution and reduce impacts compared to releases to smaller streams and upland habitat. Also refer to Appendix 3-E, Flow Management and Safety Relief Point.

A discharge impact characterization indicated that if such an event were to occur, the discharge plume from the Kenmore safety relief point would most likely extend the entire width and depth of the Sammamish River and approximately 3,800 feet into Lake Washington. The discharge impact characterization was conducted using a King County hydraulic model (HEC-2) of the Sammamish River and water quality data for untreated wastewater and the Sammamish River, and updated in 2002 (see Appendix 3-E, Flow Management and Safety Relief Point). The modeling showed that under extreme flow conditions (peak flows of 170 mgd in 2050), the river would provide acute and chronic dilution factors of 1.3:1 and 3.7:1, respectively. From these, the levels of ammonia (acute and chronic), copper (acute), lead (chronic), mercury (chronic), and turbidity (acute and chronic) would exceed Water Quality Standards at the edge of the dilution zone for hours or possibly days after the emergency overflow occurred. King County would post the area, clean up the area as appropriate, and monitor water quality in the vicinity of the overflow to determine when pollutant concentrations have returned to levels consistent with state Water Quality Standards.

Terrestrial species (e.g., Pacific treefrog, birds, mice, squirrels, shrews, rats, voles) in the vicinity of the safety relief point may be temporarily adversely affected if they are engaged in activities on the surface water of the river. Terrestrial species engaged in

feeding activity may become temporarily ill from incidental ingestion of surface water contaminated with pathogens. However, terrestrial species would likely avoid the area of discharge, thereby minimizing any temporary illness. Death of terrestrial species is not likely to occur because toxicants in wastewater discharged to the Sammamish River would not be concentrated enough to cause acute toxicity in terrestrial species from incidental ingestion. Death from incidental ingestion of acutely toxic substances (e.g., copper) may occur to relatively smaller terrestrial species (e.g., Pacific treefrog) with less tolerance than other species.

In the unlikely event that an emergency discharge occurs, it would likely occur during the later winter or early spring during extreme or prolonged wet weather conditions when wastewater flows are highest. This timing would avoid impacts to chinook, sockeye, coho salmon, and winter steelhead trout during peak upstream spawning migration (October to November) and peak downstream out-migration of juveniles (March to May). Impacts may occur during non-peak migrations later in the winter and early spring. Impacts to aquatic habitats may include lower dissolved oxygen levels, which would temporarily affect fish and aquatic organisms. Fish and aquatic organisms would likely avoid the area of discharge by migrating upstream or downstream. However, discharges occurring during periods when fish are present in the Sammamish River could result in fish mortality from acute toxicity. In addition, mortality from acute toxicity may occur to aquatic mammals (e.g. beavers) and aquatic amphibians (e.g. salamanders) that are present within the discharge area. Ultimately, most contaminants would be broken down biologically or chemically, or diluted, and water quality would return to a cleaner condition. However, some pollutants, such as heavy metals or those that do not break down in water, could be retained in sediments and may bioaccumulate in fish and other aquatic organisms, which could have a long-term effect on their health and the health of animals that forage on them. The likelihood of overflows is discussed in more detail in Appendix 3-E, Flow Management and Safety relief Point. The frequency of overflows would be substantially less compared to the No Action Alternative.

Proposed Operation Mitigation Common to All Systems: Conveyance

The operation of portal sites is not anticipated to impact sensitive areas after the portals have been constructed. Portal sites that are not retained for continued use after construction could be revegetated and monitored to ensure successful habitat reestablishment. If necessary, portal sites would have stormwater facilities to avoid or minimize impacts associated with runoff to nearby wetlands or surface waters. The low noise levels and limited nighttime lighting are not anticipated to impact nearby wildlife.

By designing the Brightwater System to provide flexibility in managing flows, the potential frequency of overflows and resultant likelihood of impacts to fish and wildlife would be reduced. During emergency flow conditions, King County would reduce the probability of an overflow by implementing five flow management strategies. These include diverting wastewater to other treatment plants, diverting wastewater to storage facilities, and implementing controlled surcharging of the existing Bothell-Woodinville interceptor tunnel and the new Brightwater influent tunnel. After implementing these

measures and considering the probability of power outages, the worst case probability for an overflow would be once every 100 years from 2010 to 2039 (Phase 1), increasing to once every 75 years from 2040 onwards (Phase 2). See Chapter 8 for a discussion of additional backup power measures that would be put in place to avoid emergency overflows.

7.3.1.3 Outfall Impacts and Mitigation Common to All Systems

Construction Impacts Common to All Systems: Outfall

Impacts to marine plants and animals would occur during outfall construction, which would require construction on both land and in water. Overall outfall construction is expected to last between 10 and 12 months. In-water open cut construction through the nearshore (the preferred construction method) would be expected to take between 2 to 3 months. Chapter 3 describes outfall construction; additional detail is provided in Appendix 3-F, Nearshore Alignment and Construction Methods Alternatives.

Overall, construction activities could result in the following types of impacts:

- Direct loss of vegetation and habitat
- Disruption of existing sediments and/or increased turbidity from sediments, causing mammals and fishes to avoid the area, and possibly temporary impacts to less mobile benthic species
- Temporary displacement of mobile aquatic organisms
- Toxicological impacts from construction-related spills and leaks
- Direct mortality to non-mobile and some less mobile benthic organisms such as clams

Nearshore trench excavation would also be sheeted from the shoreline to a depth of -30 feet MLLW with a width of about 20 feet. Nearshore trench excavation from -30 to -80 feet MLLW would not be sheeted with the width ranging from 5 to 100 feet.

Impacts to Marine Habitat Common to All Systems

Proposed construction of the outfall using open cut construction would directly impact various marine habitat types. Open cut construction would utilize excavation equipment to dig a ditch for the placement of outfall pipeline, which would then be buried by earth and rock for protection. Trench construction would extend approximately 1,000 feet on land and between 700 and 950 feet through the nearshore to -80 MLLW. Onshore trench excavation would be sheeted with a width of 10 to 12 feet. Nearshore trench excavation

would also be sheeted from the shoreline to a depth of -30 feet MLLW with a width of about 20 feet. Nearshore trench excavation from -30 to -80 feet MLLW would not be sheeted, with the width ranging from 5 to 100 feet.

Overall, outfall construction would disturb approximately 6,200 to 6,750 linear feet in Zones 7S and 6, respectively. Impacts to marine habitats would vary by outfall zone, but would impact a similar range of habitats from shoreline/riparian areas, where staging would be located, to deep subtidal habitats. Specific impact footprints for each zone are described under the Route 9 and Unocal System discussions below. Impacts to marine biota are described in the following sections.

Impacts to Marine Animals Common to All Systems

Marine Mammals

Outfall construction activities, including open cutting in the nearshore and laying of offshore pipe on the seafloor, would result in temporary impacts to marine mammals. Potential impacts include avoidance of the construction area due to noise and potential avoidance effects to prey. Outfall construction activities, including trench installation, are anticipated to require between 2 to 3 months of in-water work and would primarily occur during daylight hours.

Killer whales and California sea lions are seasonal visitors to central Puget Sound, with most sightings of killer whales occurring in the fall months. California and Steller sea lions may be present in the area from fall through late spring; occasionally, Steller sea lions may be present during summer months, but sightings are rare. These species could be temporarily displaced at times when they are present in central Puget Sound during in-water construction. In-water construction would likely occur during construction fish windows, possibly between July and early March for salmonids and bull trout and from March to October in nearshore areas for sand lance.

Minke and gray whales are uncommon in the alternative outfall zones, and any occurrences would be transitory in nature. If these two species are present during in-water construction, they would likely avoid the construction area. Harbor seals and Dall's porpoises may be present year-round in or near the vicinity of the alternative outfall zones and have the potential to be most affected by in-water construction activities. There are no identified marine mammal breeding or rearing areas within the two outfall zones.

In-water trench construction through intertidal areas to the shallow subtidal area would likely be supported by barge-mounted construction equipment. Barge-supported trench excavation would require a working barge along with several support barges. Noise generated during trench excavation and barge operations (both working and support) may temporarily displace marine mammals. Some sounds generated by the excavation equipment, spud placement, and installation of sheet piling may be loud enough during construction to cause avoidance or other disturbance reaction. For the sheetpiles used for trench installation, the use of a vibratory hammer would be preferred over the use of an

impact hammer to install the sheet piles to reduce both noise and pile installation time. The noises generated by these activities are not expected to physiologically harm marine mammals passing through the area. Noise levels causing permanent hearing impairment to marine mammals from continuous and prolonged man-made noises are likely to be above 140 dB (Richardson et al., 1995). Shoreline noise levels from nearshore open cut construction activities are expected to range from 79 to 90 dB at a distance of 50 feet and occur intermittently during construction.

From three to six barges may be required during the in-water construction. Once in place with the aid of tugboats, the barges would remain for extended periods (several days). Many marine mammals, particularly sea lions, harbor seals, killer whales, and Dall's porpoises in Puget Sound waters are habituated to frequent vessel activity and are not expected to be affected by the slight increase in vessel traffic. Minke and gray whales may not be as habituated to high levels of vessel and human activity as other marine mammals; however, the slight increase in vessel activity is expected to have minimal effect on these species. No direct loss of marine mammals is anticipated from collisions with barges or support vessels, because the likelihood of collisions occurring is extremely low. Given their highly mobile nature, it is likely that marine mammals present in the general area during construction would temporary avoid construction areas because of the noise.

No long-term indirect impacts to marine mammals through impacts to prey resources are expected. However, there may be short-term impacts to forage fish or other marine fish that would result in area avoidance. Consequently, marine mammals feeding on fish in these zones would be temporarily displaced during construction. Long-term impacts to benthic infauna are not expected because infaunal communities that are disturbed by construction activities are expected to recover to pre-construction assemblages; therefore, no long-term impacts to gray whale prey resources are expected.

Marine Birds

Outfall construction activities would result in temporary impacts to marine birds. Marine birds are likely to avoid the area and to be temporarily displaced because of noise and other construction activities. This temporary displacement could last from 10 to 12 months; the greatest disruption would occur during in-water nearshore construction, which is expected to last between 2 to 3 months. The time of year for construction would be stipulated in construction permits.

The marbled murrelet and bald eagle are listed under the Endangered Species Act as threatened species and may occur in the area. During periods when marbled murrelets may be present, typically during the fall and winter months, they would be temporarily impacted due to displacement from noise and other construction activities. If forage fish are temporarily impacted and avoid the area, marbled murrelets feeding on forage fish in these zones would also be temporarily displaced during construction. Common murres, harlequin ducks, western grebes, common loons, and other marine birds may also avoid outfall zones during construction due to noise. Other birds that feed on forage fish, such as common murres, may be temporarily impacted if forage fish are displaced by

construction activities. Birds that feed on marine invertebrates may be temporarily impacted and may be displaced by disturbance to benthic substrates from open cut construction until restoration of substrates and invertebrate populations occurs. Marine birds would be displaced to other suitable feeding areas, where available near the project area, with similar substrates until site restoration. There are no marine bird breeding, overwintering, or nesting areas within the alternative outfall zones that will be impacted.

Marine Fish

Outfall construction activities would result in temporary impacts to fish habitat and species. Fish would be expected to avoid the area and to be temporarily displaced. In-water construction activities would likely be limited by state and federal agencies to a seasonal construction window—from early July to early March—when low numbers of juvenile salmonids are migrating out through Puget Sound. Juvenile salmonid surveys conducted from May through mid-October in 2001 and 2002 in the nearshore area immediately south of Zone 7S found hatchery juvenile chinook salmon and coho salmon present in nearshore areas as early as May (King County, 2002a). While some juvenile salmonids that inhabit nearshore areas prior to early July would likely be displaced from up to approximately 25 feet of shoreline using sheeted trench installation, limiting construction to established work windows would reduce the potential to impact large numbers of chinook and coho. It is possible for a small number of nearshore epibenthic fish, such as sculpins and gunnels, to become trapped within the trench and lethally impacted.

Open cut construction may affect surf smelt and sand lance spawning habitat, depending on the final outfall alignment. Spawning habitat surveys found evidence of surf smelt and sand lance spawning throughout the eastern portion of the central Puget Sound shorelines. Both sand lance and surf smelt spawning habitat were documented in Zone 7S during habitat surveys conducted between November 2000 and February 2001, and surf smelt spawning habitat was documented in Zone 6 (King County, 2002a). There is no indication that either outfall zone is a preferred or exclusive spawning area for either species. If in-water construction occurs when forage fish are spawning, these fish are likely to be displaced and to spawn in another area if suitable spawning habitat is available elsewhere. Limiting construction to the established work window for forage fish (from March to October) would reduce potential displacement.

No Pacific herring spawning grounds have been documented along the entire eastern portion of central Puget Sound, including the alternative outfall zones.

Open cut construction would disturb and re-suspend bottom sediments, temporarily increasing turbidity in the immediate vicinity of the trench. The use of sheetpiling would reduce the area disturbed to a width of about 20 to 25 feet along the length of the pipeline to a depth of -30 feet MLLW. Sediments in the nearshore area where Open cut construction would occur are composed mainly of sand and gravel (over 95 percent); as a result, a very small sediment plume is expected to result from bottom disturbance. Fish that are present along the immediate vicinity of the outfall trench would likely be

displaced by suspended sediments. The impacts would be temporary and would depend on current and tidal conditions.

An evaluation of chemical contamination in bottom sediments (approximately the top 4 inches, or 10 centimeters) for both subtidal and nearshore areas showed no exceedances of applicable state sediment regulatory standards for chemical pollutants (King County, 2002g). Therefore, suspended sediments are not expected to have a toxic impact on fish or prey resources. Although sediments met applicable regulatory standards, it is possible that contaminated sediments may be encountered at deeper depths in inland areas that would be traversed to get to the nearshore because of the proximity of the proposed outfall zones to past and present industrial facilities. Toxic sediments could have lethal or sublethal effects on fish depending on the chemical and concentration encountered. Any contaminated sediments encountered would be disposed of at an approved sediment disposal site to minimize any further potential toxic impacts to fish in the project area. If contaminated groundwater is encountered during the onshore construction phase, this groundwater could enter Puget Sound.

It is expected that most adult fish would escape being crushed by pipeline laying activities in the offshore waters along the outfall route from -80 feet MLLW to the end of the diffuser, approximately 4,500 feet for Zone 7S and 4,800 feet for Zone 6. It is possible, however, for demersal fish (such as flatfish) to suffer direct mortality beneath the pipe. Suspended sediments from the installation of the pipeline onto the seabed are not expected to significantly impact fish because the plume of suspended sediments along the pipeline route is expected to be minimal and would not result in fish burial or interference with gill structures. It has been shown that turbidity levels from suspended sediments below 200 mg/L will avoid causing physical injury to salmonids (Nightingale and Simenstad, 2001). Suspended sediments from pipeline installation are not expected to be above 200 mg/L beyond immediate contact with the seafloor. Demersal and pelagic fish in deeper waters would likely be temporarily displaced due to pipeline laying activities during the 2- to 3-month in-water construction period.

Noise and presence of construction equipment may also temporarily displace fish in the area. Displacement is expected to be greatest during nearshore construction activities because of the higher numbers of fish potentially present and the level of noise generated during open cut construction activities. The increase in vessel traffic from in-water construction activities is not expected to impact fish because the number of barges and support vessels would be minimal, and noises generated would be similar to or less than routine vessel traffic in the area.

Shellfish

In-water trench construction would destroy bivalves residing in bottom sediments along the outfall route. Some mobile shellfish species, such as crabs and shrimps, may also become trapped in the trench and be destroyed during sediment excavation. Assuming shellfish are within 3 feet (1 meter) of the seabed surface, between 2,916 to 4,405 cubic yards (cy) of sediment that may contain shellfish may be excavated from the trench in Zone 7S, while 3,038 to 4,253 cubic yards may be excavated from Zone 6. Impacts are

expected to be greater in shallower waters where shellfish biomass is higher. If shellfish larvae are present in nearshore areas during the 2- to-3 month in-water trench construction time, they may suffer physical trauma resulting in direct mortality. If larvae are lost, this loss is not expected to significantly affect future populations of shellfish. Larvae suffer naturally high mortality rates, and recruitment of larvae from other nearshore areas of the Central Basin should occur rapidly. Re-establishment of basic physical characteristics of the disturbed site would provide for repopulation by the same species as currently occur at the site.

Turbidity from suspended sediments would likely have a minimal impact on clams and other shellfish species that are in the immediate vicinity of the outfall trench, depending on current and tidal conditions. The use of sheetpiles could reduce the area disturbed to a width of about 20 feet along the length of the pipeline to a depth of -30 feet MLLW, compared with 60 to 100 feet if the open cut construction were unsheeted. Sediments in the nearshore area where open cut construction would occur are composed mainly of sand and gravel (over 95 percent); as a result, a small sediment plume is expected from bottom disturbance and would not likely result in burial or direct mortality to any shellfish species. Crabs, particularly those of the genus *Cancer spp*., are known to burrow into sediments, and a slight increase in suspended sediments is not expected to affect behavior or physiological processes (Chang and Levings, 1976). Bivalve species have a range of capabilities to excavate themselves from sediments, and geoducks are known to survive sediment burials of over 6 inches (Change and Levings, 1976).

For motile shellfish species such as crabs and shrimp that are not trapped in the trench, impacts from open cut construction would be temporary because it is expected that these species would avoid the area during construction and move to other suitable habitat in the area.

There would be lethal impacts to geoducks and horse clams from the point where the trench ends at –80 MLLW to the end of the outfall route if these species are present underneath the installed pipeline. There may also be lethal impacts to crabs and shrimp from the point where the trench ends to the end of the outfall route if these species are present underneath the installed pipeline and are crushed. While shrimp are motile and likely to escape, it is possible that molting or recently molted crabs may not be able to escape.

The pipeline would be installed on approximately 22,500 square feet of the seabed in Zone 7S and on approximately 24,000 square feet of the seabed in Zone 6. Any shellfish not able to escape would suffer direct mortality in this area. Installation of the pipeline onto the seabed is not expected to impact shellfish from disturbance of sediments, because the suspended sediment plume from laying the pipe would be minimal.

Benthic Invertebrates

Many benthic invertebrate species (such as anemones, worms, and snails) are found in the waters and sediments of Zones 6 and 7S. In-water trench construction would destroy non-mobile benthic invertebrate species in and on the surface of bottom sediments along

the outfall route to a depth up to -80 feet MLLW. Assuming benthic invertebrates are within the biologically active zone of sediments (the top 6 inches), approximately 671 cubic yards of sediment that may contain benthic invertebrates may be excavated from the trench at Zone 7S and approximately 648 cubic yards would be excavated from Zone 6 if the trench were sheeted. If the trench is unsheeted, approximately 1,300 cy of sediment that may contain benthic invertebrates would be excavated from the trench at Zone 7S, while approximately 1,760 cy may be excavated from Zone 6.

Open cut construction activities would also disturb and resuspend bottom sediments, temporarily increasing turbidity in the immediate vicinity of the trench. Impacts to macroinvertebrates (invertebrates large enough to be seen with the unaided eye, including crabs and epibenthic invertebrates, such as sea cucumbers) would be greater in shallower waters where the abundance of these species is higher. The impacts to benthic infauna from suspended sediments would depend on the species, the organism's ability to tolerate particulates, and the amount of sediments covering the organism.

Construction of the offshore segment of the outfall would lethally impact benthic organisms directly beneath the pipeline in an area ranging from approximately 22,500 square feet of the seabed in Zone 7S to approximately 24,000 square feet of the seabed in Zone 6. Impacts to benthic infauna (invertebrates living in sediments, such as annelids and mollusks) may be higher in deeper waters where they are more abundant (King County, 2002g).

The tugboats used to maneuver and position the barges have the potential to scour bottom sediments from the prop wash, which could temporarily increase turbidity and remove aquatic vegetation and benthic organisms. The degree of potential impact would depend on the size of the barge, depth of the water during maneuvering, and characteristics of the benthic organisms. A tugboat has been estimated to have a scour depth of approximately 0.5 feet while in 8 feet of water (Boatman et al., 1995). Most in-water work and tugboat traffic associated with the Brightwater marine outfall would occur at depths greater than 8 feet, and would therefore have less impact on the seafloor.

Working barges could be anchored to the seafloor with "spuds," which are piles used to anchor and maneuver the barges. Any invertebrates directly beneath the spuds and anchors would be lethally impacted. Disturbance associated with installation of the spuds and anchors is expected to be minimal because of the lack of fine-grained sediments in the area where sediments may become suspended. Sediments in the area where the spuds and anchors would be placed are composed mainly of sand and gravel (over 95 percent), thus a very small sediment plume is expected to result from bottom disturbance (King County, 2002g). Each spud would displace approximately 0.35 to 0.46 cy of sediment if the expected penetration into the seafloor is achieved. It is expected that displaced material would quickly settle back onto the seabed. Benthic and epibenthic fauna in the immediate vicinity of the spuds may be temporarily or lethally impacted, depending on the species and the amount of material covering the organism.

Impacts to Marine Plants Common to All Systems

Open cut construction would likely remove some sea lettuce, eelgrass, and other macroalgal species, depending on the final alignment of the outfall. Based on the known distribution of kelp, little to no removal of kelp is expected. In-water trench construction would remove aquatic vegetation along the outfall route down to a water depth of approximately -20 feet MLLW. Other macroalgae present along the shoreline would be removed from within the width of the trench, about 20 feet wide to a depth of -30 feet MLLW, and 5 to 100 feet wide between -30 and -80 feet MLLW. Removal of eelgrass is discussed later in the sections devoted to each outfall zone.

No long-term or indirect impacts to macroalgae from temporary increases in suspended sediments during in-water open cut construction activities are anticipated. Suspended sediments from open cut construction activities are expected to remain in the immediate vicinity of the trench and could result in short-term light reduction, which could slow or inhibit macroalgae growth during late spring to early fall.

Depending on placement of the barges and time of year, there may be small localized impacts to aquatic vegetation in the nearshore area during the 2- to 3-month in-water construction period. Incidental localized spills of bulk materials while loading to the barge could temporarily increase turbidity, resulting in reduced light penetration and inhibited macroalgae growth. Shading impacts from barges to aquatic vegetation are expected to be minimal in late fall through early spring because growth is minimal during this time. Shading impacts to aquatic vegetation are expected to be less along the outfall alignment in Zone 7S as there is less vegetation present in this area. Shading impacts would be restricted to the immediate vicinity of the barges, which are typically 75 by 200 feet, and would vary depending on the orientation of the barges, length of time moored, and time of year.

Impacts to Tribal Treaty, Commercial, and Recreational Fisheries Common to All Systems

Outfall construction in either zone would not be expected to affect tribal treaty or non-treaty commercial fishing activities. Currently, there are no open commercial geoduck beds in either zone. The tribal shrimp fishery for spot prawns typically occurs in April in waters between -100 to -400 feet MLLW and remains open for approximately 1 week until quotas are reached. The tribal crab fishery can remain open throughout most of the year and typically occurs in waters less than -150 feet MLLW. Coho and chum salmon are fished during fall months, while sockeye are fished in July when the fishery is open. Tribal fisheries managers also regulate bottom-trawl fisheries for demersal fish in and around both alternative outfall zones. Although the bottom trawl fishery near the outfall zones has not been active in recent years, tribal fisheries managers would be consulted prior to construction activities in the event that this fishery becomes active prior to outfall construction. Tribal fisheries managers would also be consulted prior to construction activities or barge movement to minimize disruption of other treaty-protected commercial or subsistence fisheries for salmonids and shellfish, including crab and shrimp.

The current commercial fisheries near the alternative outfall zones are for salmon, Dungeness crab, spot prawns, and spiny dogfish. Commercial fishing activities correspond with migration times for various salmonids and harvest windows for shellfish. Most spot prawn and spiny dogfish fishing takes place in waters greater than -100 feet MLLW; therefore, open cut trenching construction and related activities would not directly impact these fisheries. For other fisheries and for placement of the outfall on the seafloor, commercial fisheries managers (WDFW and Treaty Tribes) would be consulted prior to construction activities or barge movement to minimize disruption of commercial fishing activities.

Impacts to recreational salmon fishing are not expected because the seasonal construction windows established by state and federal agencies would limit impacts during fishing seasons. Temporary impacts to other sport fishing may occur during outfall construction, causing fishermen to be displaced to other fishing areas due to noise and barge traffic. Trenching activities would impact recreational shellfishing in Zone 6, as access to intertidal areas would be restricted during trenching in nearshore areas. Access to intertidal areas in Zone 7S would also be restricted during trenching activities.

Recreational fishing for spot prawns is an active fishery that typically opens in late April and remains open for approximately 2 weeks. The area near the Edmonds Marina is a popular area for spot prawn fishers. Spot prawn fishers may be temporarily displaced to other fishing areas if construction occurs during the harvest window.

Recreational squid harvesting occurs in many areas of the Central Basin typically from late fall through March, particularly at public access beaches with fishing piers such as the Unocal pier in Zone 6. Squid fishing occurs at night and is not expected to be impacted by construction activities in Zone 7S because there is no public access. Impacts to squid fishing in both zones are also expected to be minimal because most construction would take place during daylight hours.

Risk of Spills Common to All Systems

Construction-related accidents or spills are possible during the construction of the outfall. These accidents and spills could include the release of petroleum products and excavated sediments either on land or in the waters of Puget Sound, resulting in potential displacement of or stress to the health of aquatic or terrestrial organisms. The possibility for accidents or spills would be minimized by implementing appropriate spill prevention measures for the handling and storage of fuels, oils, lubricants, and other products. Refer to Chapter 9 for more information.

Operation Impacts Common to All Systems: Outfall

Impacts from outfall operation would be largely the same for each outfall zone, as discussed below, except that rarely, emergency overflows could occur at outfall Zone 6 under extreme conditions associated with operation of a treatment plant at the Unocal site. Emergency overflows associated with the Unocal system are discussed in more detail under the Zone 6 section later in this chapter.

Overall, due to the high effluent quality, impacts to plants and animals are expected to be minimal. Once construction of the outfall is complete, treated effluent would discharge at a depth of about -600 feet MLLW. The discharge point would be at least 4,700 feet offshore for each outfall zone. The effluent plume is expected to remain below the euphotic zone under most operating conditions. Impacts from operation are discussed in greater detail below.

Regular maintenance requirements for the outfall and diffuser would include cathodic protection monitoring of steel pipelines and periodic visual inspection of the outfall. Inspection and maintenance of the cathodic protection system would not require equipment that would impact biological resources. In-water inspection of the outfall would only minimally disturb sediments near the outfall and diffuser.

Constituents of Concern in Wastewater Effluent Common to All Systems

The potential impacts to plants and animals from the discharge of treated wastewater effluent are generally related to three categories of contaminants: (1) physical parameters; (2) nutrients; and (3) metals and organic chemicals. Risks associated with bacteria, viruses and other pathogens largely relate to human health and are discussed in Chapter 9.

Marine plants and animals could come in contact with constituents of concern as a result of spills or leaks of untreated wastewater, or to a much lesser degree from contact with treated effluent. Overall, potential risks to plants and animals associated with discharge of treated secondary effluent are substantially lower than the risks associated with discharge of untreated wastewater or primary-treated effluent. However, some constituents can remain in treated effluent, at very low concentrations, even when all applicable effluent quality standards have been met. The following sections provide a brief summary of constituents of concern associated with treated wastewater and potential impacts to plants and animals. Additional information on marine water quality is provided in Chapter 6.

Both an acute and chronic mixing zone would be established around the discharge point. The maximum chronic mixing zone is a horizontal distance from the diffuser of 200 feet plus the depth of the diffuser below MLLW. The acute mixing zone is 10 percent of the chronic zone. For a diffuser at a depth of approximately –605 feet MLLW, the corresponding mixing zones would be 805 feet and 80.5 feet. The size of the mixing zone would be determined during permitting, but based on existing King County outfalls the mixing zone could extend horizontally approximately 800 feet from the diffuser. The potential for impacts beyond this regulatory mixing zone is discussed below.

Physical Parameters

Physical parameters that may potentially affect marine plants and animals include salinity, turbidity/total suspended solids, dissolved oxygen/biochemical oxygen demand, and temperature. For each of these parameters, the degree of mixing between the treated effluent and Puget Sound water would ensure that there would be no measurable impacts beyond the regulatory mixing zone. For example, temperature is expected to be indistinguishable from ambient conditions beyond the mixing zone. Within the regulatory mixing zone, it is possible that some marine life such as the early life stages of shrimp may be excluded from a small area due to decreases in salinity. Analyses of the potential for Brightwater discharges to affect dissolved oxygen concentrations in Puget Sound are discussed in Appendix 6-I, Effluent Quality Evaluation for the Membrane Bioreactor and Advanced Primary System. The calculated oxygen drawdown for the Central Basin of Puget Sound and Possession Sound is well within regulatory requirements.

Nutrients

Nutrients include nitrogen and phosphorus compounds that are essential for life. In Puget Sound, nitrogen compounds play an important role in regulating algae growth. Algae growth in the Central Basin of Puget Sound tends to be low in the winter, followed by an acceleration of growth known as a "bloom" in the spring, a late spring rapid dieoff or "crash," a summer bloom, and an early fall bloom followed by a fall crash.

Nutrients, including nitrogen and phosphorous compounds, are present in treated effluent. The membrane bioreactor (MBR) process would create a favorable condition for nitrification and can achieve ammonia removal efficiencies as high as 99 to 100 percent, depending on the system configuration. Analysis of the impacts on nutrient levels in Puget Sound, and resulting impacts on algal growth and dissolved oxygen, is contained in Appendix 6-I, Effluent Quality Evaluations for the Membrane Bioreactor and Advanced Primary System. Discharges from the Brightwater Treatment Plant would have minimal impact on nutrient levels in Puget Sound.

While a causative link has never been established between nutrient loading and the bloom of organisms causing paralytic shellfish poisoning (PSP) or other biotoxins, excessive nutrients could alter the patterns of algae growth in Puget Sound. These blooms appear to be naturally occurring throughout Puget Sound. King County would continue to monitor the results of ongoing investigation and research relating to the topic and incorporate results into its operational practices as warranted. Refer to Chapter 9 for more information on the health effects of toxic algae blooms.

Metals and Organic Chemicals

Metals and organic chemicals in treated effluent may impact aquatic life in a variety of ways. These chemicals may pose health risks to aquatic life such as fish or crabs, or to marine mammals and birds. Metals are naturally occurring elements. Human activities may cause an increase above natural levels for some metals when they are mined, refined, and released elsewhere in the environment. Metals do not break down and are considered

to be persistent chemicals. In general, metals will bind to sediment or to particulates suspended in water, but they may also dissolve in the water, accumulate in the sea surface microlayer, or bioaccumulate in the tissues of marine life. Most metals are detected in treated effluent, some at higher levels than are naturally found in Puget Sound water. Anticipated levels of constituents in Brightwater secondary-treated effluent are discussed below.

Organic chemicals may be either naturally occurring or human-made. In general, organic chemicals will biodegrade over time to their component elements, although some persistent organic chemicals may not break down for decades. Organic chemicals vary greatly in their mobility through the environment and their decomposition rate. As with metals, organic chemicals may accumulate in sediments, bind to particulates suspended in water, dissolve in water, accumulate in the sea surface microlayer, or accumulate in the tissues of marine life. In addition, the rate of bioaccumulation in fish tissues varies among chemicals and fish species. Many organic chemicals are not detected in treated effluent; those that are detected include some that are at higher levels than are found in Puget Sound water.

In general, metals and organic chemicals discharged to Puget Sound may potentially cause a variety of effects to marine life. The types of effects that may potentially occur would vary depending on the chemical and the level of exposure. At high enough exposures, chemicals in water, sea surface microlayer, sediments, or tissues may cause immediate health risks, including death, to marine life. At lower levels, long-term effects to marine life, such as those that may be associated with reproduction or growth, may potentially occur. In addition, some chemicals known as endocrine disruptors may interfere with the operation of the endocrine system.

The potential for chemicals to directly affect aquatic life from discharge of treated effluent was evaluated in four general locations (Parametrix and Intertox, 2002):

- At the edge of the acute regulatory mixing zone
- At the edge of the chronic regulatory mixing zone
- Where the plume intersects the bottom of Puget Sound
- At sensitive nearshore habitat

Anticipated levels of constituents in Brightwater secondary-treated effluent were estimated by evaluating the influent from the existing South Wastewater Treatment Plant and the removal efficiencies expected for the Brightwater treatment processes. This evaluation indicates that constituents from the Brightwater outfall would meet all existing water quality standards at the edge of the mixing zone and are not expected to affect marine biota (Parametrix and Intertox, 2002, and Appendix 6-I, Effluent Quality Evaluation for the Membrane Bioreactor and Advanced Primary System).

Extensive modeling and a review of the scientific literature has shown negligible risk of causing adverse effects to aquatic plants and animals at the edge of the regulatory mixing zone (Parametrix and Intertox, 2002).

One chemical, 2, 4-dichlorophenol, was never detected in offshore Puget Sound water. The detection limit for 2, 4-dichlorophenol is greater than the concentration that may be harmful to algae; therefore, there is some uncertainty regarding the potential impacts from this chemical. However, it is estimated that the theoretical maximum increase of 2,4-dichlorophenol concentrations resulting from the discharge would range from 0.00016 – 0.0037 µg/L for the acute mixing zone, and 0.00002 – 0.00015 µg/L for the chronic mixing zone. The theoretical maximum increase at the edge of the chronic mixing zone would exceed the concentration that may be harmful to algae; however, this would only occur less than 1 percent of the time. Furthermore, the algae-based toxicity value is several orders of magnitude less than the next lowest chronic toxicity value, and may be overly conservative. Therefore, no effects to plants or animals are predicted (Parametrix and Intertox, 2002).

Under numerous effluent discharge scenarios modeled using an effluent discharge model called PLUMES, the median dilution at the edge of the chronic mixing zone (where discharge is regulated) ranged from 300:1 to 1,821:1 (Appendix 6H, Predesign Initial Dilution Assessment). Ecology guidelines recommend a 100:1 dilution at the edge of the chronic mixing zone.

The diffuser would be located in deep water where fewer numbers and types of marine biota, particularly aquatic vegetation, are found compared to shallow nearshore waters. Marine vegetation is nonexistent deeper than approximately -40 feet MLLW in either of the outfall zones. There may be a small change to benthic infaunal communities in the immediate vicinity of the diffuser that may result in an increase of organic-tolerant species, but this effect would be minimal and highly localized.

Fate and transport effluent modeling has shown that there would be no onshore transport of the effluent under predicted operating conditions; therefore, no impacts to marine biota in nearshore areas are expected. Fish, marine mammals, and other motile species would not be impacted due to the initial dilution of the effluent and limited exposure time. Prey resources for marine biota in the two zones also would not be impacted.

In the event of a failure or an accident in which untreated wastewater is discharged, particulate-associated contaminants in the effluent mixing zone may settle out on top of marine sediments in the vicinity of the outfall diffuser. The contaminants may adversely affect benthic organisms depending on the amount discharged and time of year (benthic organisms exhibit seasonal population fluctuations). In the event of an emergency in which untreated wastewater is discharged, fish and other motile species would likely avoid the area. Discharge of untreated wastewater to Puget Sound would be highly unlikely because several flow management strategies would be implemented to greatly minimize the chances of a marine discharge of untreated wastewater. Refer to the conveyance impacts discussion earlier in this chapter and Appendix 3-E, Flow Management and Safety Relief Point.

Impacts to Benthic Organisms from Metals and Chemicals that Accumulate in Sediments

Potential impacts to benthic organisms from constituents that accumulate in sediments, including metals, PAHs and other organic chemicals, were investigated by King County (Parametrix and Intertox, 2002). This evaluation was conducted for sediments next to the outfall alignments, for sediments located where the effluent plume intersects the Puget Sound bottom, and at sensitive nearshore areas. Chemical concentrations in sediment next to the outfalls were estimated using sediment data from near the South Treatment Plant outfall because the effluents of the South and Brightwater Treatment Plants are expected to be similar. The results of this study are considered conservative because MBR technology would, overall, produce effluent of better quality. Chemical concentrations in sediments distant from the outfall were estimated by multiplying measured sediment concentrations from the South Plant outfall by the percent increase in waterborne chemical concentrations that are expected to occur when the Brightwater outfall is operating. In all instances, chemical levels in sediments were predicted to be protective of benthic organisms according to Washington State Sediment Management Standards.

Impacts to Aquatic Life from Chemicals that may Accumulate in the Sea-Surface Microlayer

The proposed wastewater treatment plant and outfall would minimize the effects of effluent discharge on the sea surface microlayer. The proposed treatment facilities would provide state-of-the-art treatment of all wastewater parameters, including floatables and the potential contaminants that may associate with the floatables. An evaluation of the effects of discharge on the sea surface microlayer is provided in Appendix 6-G, Assessment of Buoyant Materials and the Microlayer.

The alternative outfall locations would maximize dilution of wastewater in the vicinity of the discharge. The proposed deep diffuser would maximize initial dilution and trap the effluent plume as deep as possible in the "Triple Junction" region of Puget Sound, where the Central Basin of Puget Sound, Possession Sound, and Admiralty Inlet converge. Buoyant materials (floatables) in the effluent—such as fats, oils, and greases, and the particles entrained in them—would undergo maximum mixing and assimilation as they rise to the water surface. Physical, chemical, and biological processes may also further inhibit vertical rise of contaminants, and/or assimilate the contaminants during the vertical rise phase.

Once at the water surface, winds, tidal currents, and density-driven currents (estuarine circulation produced by density differences between river runoff and ocean water) would transport floatables. The predominant net transport would be directly out of Puget Sound because of the strong surface density currents opposing transport southward into Puget Sound or northward into Possession Sound. The density currents may be opposed or aided by wind-driven currents depending on the predominant wind directions. The predominant wind directions are from the northwest during summer, creating the potential for direct onshore transport of floatables, and from the south during winter, aiding net seaward transport. However, siting the diffuser in deep water far from the

shoreline would minimize contact of neutrally buoyant effluent constituents with Puget Sound shorelines. Tracer releases simulating the effluent plume from the proposed site showed no detectable hits on adjacent shorelines for four days following release.

Impacts to Aquatic Life from Chemicals that Bioaccumulate Through the Food Web

King County produced a report that summarizes current knowledge regarding chemical bioaccumulation in Puget Sound (Parametrix and King County, 2002). The report evaluates whether or not King County's secondary-treated effluent discharges to Puget Sound are significant sources of bioaccumulative chemicals relative to other sources. While this evaluation was conducted using information from the South and West Point Treatment Plants, it is expected to be applicable to the Brightwater Treatment Plant because MBR treated effluent would be as good or better compared to conventional activated sludge treatment, and the affected food web is largely the same.

The report identifies 33 chemicals that are generally agreed by Ecology, EPA, and the United Nations Environment Program (UNEP) to be of greatest concern because of their persistence, their ability to bioaccumulate, and their toxicity. These chemicals are referred to as PBTs. To assess whether these chemicals bioaccumulate in the Puget Sound food web, existing chemical concentration data were reviewed for the following media:

- King County wastewater treatment plant influent, secondary treated effluent, and reclaimed water at the South and West Point Treatment Plants
- Puget Sound ambient water throughout the Central Basin
- Puget Sound sediments in the vicinity of King County's secondary treated effluent marine outfalls, as well as throughout north, central, and south Puget Sound
- Fish and marine mammal tissue from throughout Puget Sound

There are currently no agreed-upon federal or state screening values or other criteria to determine potential risks to aquatic life or humans from biomagnifications of bioaccumulates through the food web. Currently, water quality standards and criteria promulgated by regulatory agencies are protective of direct effects on aquatic life; only some standards and criteria account for bioaccumulative effects. No group or agency has proposed a specific list of concentrations that can be used to screen water column concentrations or a list of tissue concentrations that are protective of aquatic life. Therefore, King County evaluated the 33 persistent, bioacculmulative, and toxic (PBT) chemicals based on whether the available data suggest that these chemicals are bioaccumulating and whether King County's secondary-treated effluent discharges are likely to be a significant source relative to other sources. The 33 PBTs were evaluated and placed into one of four categories:

Category 1, No Data. Data for eight PBT chemicals were either not available or insufficient to evaluate whether these compounds are bioaccumulating within the Puget Sound food web, or whether King County's secondary treated effluent discharges are a

significant source of these chemicals to Puget Sound. It is unknown if these chemicals are present in environmental media in Puget Sound and, if present, whether they have the potential to cause negative effects to aquatic life through bioaccumulation in the food web.

Category 2, Non-Accumulating PBTs. Existing data for 12 PBT chemicals suggest that they are not bioaccumulating in the Puget Sound food web. It is unlikely that King County's secondary treated effluent discharges would affect marine resources.

Category 3, Inconsequential King County Contribution. Existing data for 12 PBT chemicals suggest that they are bioaccumulating in the Puget Sound food web. However, relative to other sources in Puget Sound, King County's secondary-treated effluent discharges are unlikely to be a significant source of these chemicals.

Category 4, Uncertain King County Contribution. Existing data for one PBT chemical, mercury, suggest that it is bioaccumulating in the Puget Sound food web; however, the existing data are insufficient to determine whether King County's secondary-treated effluent discharges are a significant source relative to other sources in Puget Sound. King County has developed an aggressive mercury reduction program for discharges to the wastewater collection system. This program includes permitting of all industrial discharges and a mercury reduction program for dentists.

Additional evaluation would be required to better understand if bioaccumulation of these chemicals may be negatively affecting aquatic life and/or human health in Puget Sound, or to quantify the contribution from King County's secondary-treated effluent discharges. King County will continue to evaluate this potential.

Effects to Aquatic Life from Endocrine Disrupting Chemicals

King County and Parametrix have published a document, *Endocrine Disruptors in Secondary Treated Effluent: Toxicological Effects in Aquatic Species* (Parametrix, 2002a) that discusses endocrine-disrupting chemicals, their toxicological effects on aquatic species, and the current state of endocrine disruptor research. Currently, there are no regulatory standards for surface waters or wastewater for these chemicals.

Secondary treatment of wastewater removes a substantial fraction of the endocrine disrupting chemicals in untreated wastewater. Membrane bioreactor (MBR) treatment, the selected treatment technology for the Brightwater treatment plant, would likely remove these chemicals as well as or better than other secondary treatment methods (Appendix 6-I, Effluent Quality Evaluation, Membrane Bioreactor and Advanced Primary System). Wintgens et al. (2002) reported MBR removal efficiencies for nonylphenol, an endocrine disruptor, of greater than 90 percent. Despite treatment, a small fraction of some potential endocrine disruptors may pass through the wastewater treatment system and reach receiving waters (Stahlschmidt-Allner et al., 1997; Ternes et al., 1999). The potential effects of these chemicals on aquatic health are uncertain. The endrocrine literature study (Parametrix, 2002a) suggests that research to date indicates that most endocrine disrupting effects in treated effluent are associated with natural and

artificial hormones. However, many other chemicals have also been identified as possible endocrine disruptors with similar estrogen or androgen-like effects. Because this is an emerging area of research, many new studies are underway. King County is participating in studies on a national level and will continue to monitor research results and incorporate findings into its wastewater management approach as appropriate.

Impacts to Tribal Treaty, Commercial, and Recreational Fisheries Common to All Systems

Outfall operation is expected to have minimal impacts on current tribal treaty and non-treaty commercial fishing activities in either of the outfall zones. The geoduck harvest area near outfall Zones 6 and 7S is closed to commercial harvest due to potential pollution from point and nonpoint sources along the entire eastern shoreline near the outfall zones. An additional closure zone around the outfall sited in Zone 6 or a new closure zone at an outfall sited in Zone 7S may be established by the Washington Department of Health. This closure zone would prohibit geoduck and other bivalve harvest near the outfall in the event that the area offshore is eventually opened to harvest. Establishing a closure zone around an outfall is a health-related procedure and depends on the size of the discharge, level of agreed upon treatment, and proximity to biological resources. Once operational, the outfall is not expected to result in any harvest closure beyond bivalves.

The exposed pipeline could impact fishing operations in the outfall zone due to the entanglement of fishing gear, including shrimp pots and bottom trawls. King County's outfalls are constructed with armoring materials to minimize impacts to fishing gear and nets.

Outfall operation under predicted conditions is not expected to affect shore-based recreational fish and shellfish harvesting. The discharge point would be more than 4,700 feet offshore and at a depth of approximately –600 feet MLLW where the effluent plume would not rise to the water surface. The effluent would be rapidly dispersed and would not be transported to shore. In the event of an emergency sanitary sewer overflow, the recreational fish and shellfish harvest may be affected depending on the amount discharged, time of year (whether recreational harvest is allowed by WDFW), tidal and current conditions, and final location of the outfall. The potential for impacts would, however, be minimized because untreated wastewater would discharge well offshore through the same deepwater outfall that would discharge treated wastewater. During an emergency, a closure of recreational harvest areas may be warranted as a precautionary measure.

Effects to Animals from Presence of Pipe Common to All Systems

Once construction of the outfall is complete, disturbed marine habitat is likely to be repopulated by benthic organisms shortly after restoration through settlement of larvae and migration from adjacent undisturbed habitat. Reestablishment of basic physical characteristics would provide for repopulation by the same species that currently occur at

the site. Growth of new organisms depends on size and life span. Many invertebrates have short life spans and will reach maturity within the first year. Longer-lived species such as larger clams will take several years to reach maturity and adult sizes.

Below –80 feet MLLW, the outfall would be laid on the seabed and would alter the existing marine habitat in its immediate vicinity. The exposed pipeline, approximately 5 feet in diameter, could potentially act as a barrier to the free movement of crabs. Video monitoring of existing King County outfalls shows several areas where the seabed below the pipeline has washed away. This observation indicates that sediment movement may still occur and that these gaps may provide a transport corridor for crabs (King County, 2002c). The pipeline is not expected to restrict free movement of other macroinvertebrates or fish.

The pipeline would provide new hard substrate supporting a different variety of marine invertebrates and fish than currently exists in the silt-sand sediment. Diversity and biomass are likely to increase as the result of more surface area and hard substrate. Organisms encrusting existing outfalls in Puget Sound typically include sea anemones, sea stars, and bryozoans.

Noise generated during operation of the outfall is not expected to impact marine organisms. Marine mammals are not expected to be disturbed by noise that may be generated from the effluent flowing through the pipe because of the thickness of the pipe (approximately 0.75 inch-thick for steel), the depth at which the pipe would be laid on the seafloor, and the minimal exposure time in the vicinity of the outfall. A study regarding potential impacts to marine mammals from noise generated by operation of an undersea gas pipeline in Georgia Strait, British Columbia, found that use of steel piping combined with a concrete coating reduced purported pipeline-generated noise to levels below those found in the quietest deep ocean locations (Marko, 2003; Potter, 2000). Steel is the preferred pipeline material for the Brightwater outfall, although other materials are under consideration. If steel is selected, a coating would be added to the pipe. It is expected that noise generated from a coated steel pipe would have similar noise-dampening properties as the Georgia Strait gas pipeline. Marine organisms, including fish, benthic macroinvertebrates, and marine mammals, have all been seen near other existing King County marine outfalls during underwater video surveys and above-water surveys.

Proposed Mitigation Common to All Systems: Outfall

Implementation of mitigation measures can avoid, minimize, rectify, reduce, eliminate, or compensate for adverse impacts associated with the proposed outfall construction. Mitigation alternatives for construction and operation of the Brightwater outfall are strongly influenced by the habitat, associated species potentially disrupted by the outfall, and the nature of the impacts.

Opportunities for onsite mitigation are limited because of the highly degraded/developed condition of the shoreline. Therefore, it may be appropriate to consider restoration of habitat outside the outfall corridor. Additional feasibility analysis, screening, and

consultation with regulatory agencies will be required to determine the most effective mitigation strategy for the project.

Proposed mitigation for all outfall systems is as follows:

Construction

- For upland portions of the outfall construction, clearing of vegetation would be minimized where feasible and vegetation remaining onsite protected from damage during construction.

- Appropriate best management practices would be employed to avoid and minimize the potential for construction impacts, including erosion and sedimentation, and accidental and incidental discharge of pollutants.

- Compliance with applicable federal, state, and local environmental regulations would mitigate for impacts to sensitive areas during construction of the outfall.

- A Spill Prevention, Containment, and Control Plan would be prepared and followed, as described in Chapter 9.

- Similar to construction of the treatment plant and conveyance, Section 7 of the Endangered Species Act (ESA) would likely require consultation with NOAA Fisheries and/or USFWS and preparation of a biological assessment regarding potential impacts to federally endangered and threatened species. King County will comply with any requirements imposed by NOAA Fisheries and/or USFWS regarding federal special status species.

- Temporary loss of habitat from trench excavation would be mitigated in part by sheeting the trench to approximately -30 feet MLLW and restoring the existing substrates with similar materials placed to match the pre-construction bathymetry or topography. To the extent possible, and allowed by regulatory authorities, the excavated material would be used to replace the substrate. Reestablishment of plant (vascular and algae), invertebrate, and fish species would be variable depending on the characteristics of the disrupted habitat. Shoreline riparian habitat would be replanted with the existing or native plant species, in consultation with the property owner. This restoration may take several years to develop natural characteristics; monitoring and maintenance of the plantings would occur during this time to ensure success.
- Intertidal and shallow subtidal eelgrass would, at a minimum, also be planted to reestablish pre-disruption coverage. Eelgrass would be transplanted to the disturbed site to shorten the time for restoration of existing coverage. Eelgrass transplanting has had mixed results in the past; thus, it is proposed that recent techniques developed to provide a reasonable rate of success for transplants be used. Recent research has shown that eelgrass roots establish and maintain an oxygenated zone around the roots. Providing a short-term source of oxygen that

allows the roots to establish this zone in the sediment would enhance survival rates of transplanted stock. The other algal species documented within the outfall zones are likely to quickly reestablish where appropriate substrate is present at appropriate tidal elevations; therefore, no additional restoration work is planned.

- Mitigation for the loss of geoducks and other shellfish due to trench excavation would include compensation to the Washington State Department of Natural Resources (WA DNR) for their monetary value.
- Mitigation for the shellfish closure zone and lost harvest opportunities would be provided by monetary payment to the State of Washington in accordance with WA DNRs Natural Resource Damage Assessment (NRDA).
- Organisms, such as fish, birds, and mammals, may be temporarily impacted by artificial light and noise during construction activities and may be displaced. The noise during nearshore construction and installation of sheetpiles would be mitigated by using a vibrating hammer to reduce noise and time required to install the piles. There is no critical habitat for any particular species located along the proposed alignments; therefore, no other specific mitigation for light and noise is proposed because organisms are expected to the return to the area following construction completion.
- Construction in the intertidal and shallow subtidal zones would be limited to seasonal constraints outlined by WDFW in the Hydraulic Project Approval (HPA) to limit adverse impacts to marine mammals and salmon migration along the shoreline.
- During in-water construction, King County will coordinate with affected Treaty Tribes including the Suquamish and Tulalip Tribes to reduce the potential for disruption of treaty fishing operations.
- To mitigate the potential impacts from fishing gear entanglement, King County will consult with tribal and state biologists to design the pipeline to minimize or eliminate the possibility of entanglement.
- Sand lance and surf smelt spawning habitat and some larval or juvenile macroinvertebrates may be lost during trench excavation. Loss of these organisms would be mitigated for by limiting construction to work windows, using sheetpiles to minimize trench footprint, and restoring habitat. These organisms are expected to return to the area following habitat restoration.

Operation

- Although there are no significant anticipated impacts to Puget Sound waters due to effluent discharge, a routine monitoring program would be established around the diffuser once the outfall is operational. Mitigation for the water quality mixing zones would be provided by a multi-port diffuser structure. Such a structure promotes rapid mixing of the effluent and minimizes the amount, if any, of the water column habitat that is degraded from exceedances of Water Quality Standards.

- The MBR treatment process (with ballasted sedimentation for peak flows) would reduce the annual loading of contaminants to Puget Sound by about 75 percent relative to conventional activated sludge treatment.
- Refer to Chapter 8 for a discussion of backup power facilities that would be put in place to prevent emergency overflows.

Potential Mitigation Common to All Systems: Outfall

- King County could contribute to offsite habitat restoration/enhancement projects. Numerous possibilities exist in the Puget Sound area, potentially including improving habitat in the Duwamish estuary, wetland creation/restoration in the Snohomish River estuary, or by providing funding to other non-profit or governmental groups to improve nearshore habitat or salmon spawning habitat in the smaller creeks and estuaries that flow into Central Puget Sound.
- King County could support studies regarding distribution, abundance, and timing of juvenile invertebrates, such as Dungeness crab and spot prawns, in nearshore areas as a mitigation alternative. This support could include providing funds to agencies, programs, or other appropriate parties with the objective of determining nearshore usage of juvenile invertebrates.
- If appropriate to address identified habitat impacts from the Brightwater outfall, King County could recommend the creation of or assume responsibility for a marine protected area. Possibilities include creation of a new marine protected area, expansion of an existing area, or provision of funding to maintain and operate an existing marine protected area. Currently marine protected areas exist offshore of Edmonds and Vashon-Maury Island.
- Other measures could include the removal of derelict hard structures from offsite locations.

7.3.2 Impacts and Mitigation: Route 9 System

This section describes potential impacts to plants, animals, wetlands, and streams and mitigation specific to the Route 9 System. The analyses of impacts and mitigation described in this section are more refined than those described in the Draft EIS.

7.3.2.1 Treatment Plant: Route 9

Impacts to habitats, including wetlands, and associated fish and wildlife species would primarily occur during construction. However, most of these impacts are related to the activities necessary for stream relocation and wetland/stream mitigation likely required during environmental permitting. Few impacts to habitats, including fish habitats, would occur as a direct result of treatment plant construction on the Route 9 site.

Construction Impacts: Route 9 Treatment Plant

Habitat impacts are summarized in Table 7-16. Although most of the Route 9 site is currently developed, treatment plant construction would result in the loss of a small offsite wetland, the loss of a small area of upland forest (including the wetland buffer) for pipe installation near the east site boundary, and a temporary loss of open water wetland habitat (Wetland E). In addition, habitat changes and tree removal would occur as a result of stream relocations and other sensitive area mitigation required during site permitting.

Upland Habitat and Associated Species

Some upland forest and most grassland habitats would be converted to forested and scrub-shrub wetlands and riparian areas as part of the stream location and mitigation proposed for the south and north ends of the site. Tree removal would be required for the stream relocations, but no significant loss of mature forest habitat is anticipated. Animals most likely to be affected during this time include ground dwellers such as voles, mice, and garter snakes, and shrub nesting birds such as American robin. Individual animals may experience mortality, the loss of eggs or young, or the loss of foraging areas during habitat restoration and enhancement activities. Wildlife species composition is likely to change in mitigation areas as a result of habitat changes.

Most construction activities, with the exception of the stream relocations and associated mitigation activities, would occur on already developed commercial areas. Species that may potentially be affected by construction noise and activities in adjacent forest habitats include black-capped chickadee, golden-crowned kinglet, pileated woodpecker, red-tailed hawk, black-tailed deer, and Pacific chorus frog. Birds may be flushed from their nests, or may avoid nesting, foraging, or perching in areas located near the construction activities. Mammals and amphibians may be affected in a similar manner.

Approximately 1 mile of new electrical line would be required from the Turners Corner substation at the intersection of SR-9 and 228th Street SE to the Route 9 site. The new line and an existing 12kV line would be constructed approximately 30 feet east of the existing 12kV line alignment. Small impacts to habitat could occur from the augering for pole locations approximately every 300 feet and minor concrete and earthwork at each location. Energy for the plant cogeneration facility may also require construction of 3 miles of new high-pressure gas line from Clearview at the intersection of SR-9 and 184th Street SE to the site. Construction of this line may similarly entail some vegetation clearing and impacts to upland habitat, however, the level of anticipated construction is not expected to result in significant impacts to plants and animals. As the form and location of specific energy facilities is determined in the design process, appropriate additional environmental review will be conducted as needed.

Table 7-16. Potential Habitat Loss (in Acres) or Changes on the Route 9 Site

Habitat Type	Habitat Loss or Changes [a]	Common Species Affected	Special Status Species Affected
Upland forest	1.5 - drainage pipe installation will remove upland forest offsite, east of the site boundary 0.87 - Stream relocations will require tree removal and impacts to upland forest on the north portion of the site.	Golden-crowned kinglet, black-capped chickadee, mountain beaver, black-tailed deer, and other forest species	Pileated woodpecker, bat species, Vaux's swift, and other forest species
Upland grassland	2.32 - most of this habitat would be lost as it is converted to wetland, stream and upland stream buffer during mitigation.	Savannah sparrow, meadow vole, and other grassland-related species	Foraging opportunities for red-tailed hawk would change. New, shaded rearing ponds and stream channels would benefit coho salmon.
Forested/ shrub-scrub wetland and riparian	0.10 – offsite wetland to be lost during drainage pipe installation. 0.26 – Wetland B hydrology would be impacted by stream relocation. 0.25 – riparian shrub vegetation along Wetland E and the fish ladder would be removed and relocated to the north. 0.44 – temporary disturbance would occur in some areas as the result of stream/wetland relocations. However, removal of large trees would be avoided wherever possible.	Habitat enhancement and restoration should ultimately increase the diversity and abundance of warblers, flycatchers, and other birds, mammals, amphibians, and reptiles.	Enhancing and restoring this habitat type would improve habitat conditions for coho salmon, willow and olive-sided flycatcher, green and great blue heron and others.
Emergent wetland	0.41 – some emergent wetland areas will be converted to forested-shrub-scrub wetland/riparian habitats.	Same as above.	Same as for upland grassland habitat.
Open water	0.14 – Wetland E would be filled for treatment plant construction and relocated to the north where several ponds would be created along a new stream channel. During relocation lasting up to 2 years, fish rearing habitat in the ponds would not be available on the site.	Temporary loss of habitat for waterfowl, such as mallard and Canada goose, and fish, such as juvenile coho salmon and cutthroat trout, during pond relocation.	Temporary loss of habitat for open water-related species such as coho salmon and great blue heron during pond relocation.

[a] Anticipated habitat losses/changes from stream relocations and mitigation are estimates based on conceptual mitigation design areas, which will be further refined during permitting.

Special Status Species

Habitat on the north and south portions of the site would, over the long term, be preserved and enhanced. Coho salmon should benefit directly from stream relocations and habitat restoration in the long term. However, temporary habitat loss and even mortality may result when the existing fish-rearing pond (Wetland E) is removed, especially if it is removed before new ponds to the north are installed and fully functioning.

Habitat for other species, such as pileated woodpecker and red-tailed hawk, would be temporarily disturbed as trees are removed, but would ultimately be preserved or enhanced through establishment of mitigation areas. The pileated woodpecker and red-tailed hawk, known to forage on the site, may avoid nesting and foraging in adjacent habitats during construction. Other special status species as described in the Affected Environment section, although less likely to be present on the site, may also avoid using habitats adjacent to construction activities.

Wetlands and Fish Habitat

Wetland, stream, and buffer impacts are summarized in Table 7-17 and shown in Figure 7-31. An 0.1-acre offsite, side-slope seep wetland and its forested buffers would be lost during the construction and installation of a drainage pipe immediately east of the site boundary. Two of the five onsite wetlands would be relocated and portions of the streams (Howell Creek, 228th Street Creek, and Unnamed Creek) and other drainages would be relocated and/or reconstructed to provide sensitive area mitigation. Wetland E and its associated riparian shrub habitat will be removed during project construction and relocated to the north as a series of ponds associated with a relocated stream (Figure 7-31). Wetland B would experience a loss of or change in wetland hydrology when Unnamed Creek, the main source of surface water to Wetland B, is relocated to the south. Wetland B habitats may convert to upland forest and shrub habitats as a result of this stream relocation. Currently developed buffer areas of Wetland C, 228th Street Creek, and an offsite wetland would remain in their developed state.

Wetlands C and D would be integrated into a larger wetland and stream complex mitigation area (see the proposed mitigation section). Overall, this would improve the long-term functions and values of the wetlands, particularly for wildlife and fish habitat. Hydrologic changes to these wetlands are likely to beneficially affect wetland functions including stormwater control, water quality improvement, fish and wildlife habitat, and stream base flow and groundwater support. For example, more storage for stormwater may be available in enhanced wetlands and open water may be present for amphibian breeding during a longer period of time in the spring.

Specific impacts to fish and riparian habitat on the Route 9 site include temporary impacts to 228th Street Creek and its associated fish-rearing pond (Wetland E), Howell Creek, Unnamed Creek, and buffer impacts to Little Bear Creek.

Channel A of 228th Street Creek, combined with watercourses, would be relocated in order to create a sinuous stream through the proposed mitigation area (Figure 7-31) (see Proposed Mitigation section). The fish habitat benefits provided by the existing rectangular fish-rearing pond (Wetland E) and 228th Street Creek would be incorporated into and enhanced by stream and wetland habitat mitigation areas.

Table 7-17. Potential Impacts to Wetlands, Streams, and Buffer Areas on or Near the Route 9 Site

Wetland/ Stream	Impacts (in acres)			
	Wetland/Riparian Area	Developed Buffer	Upland Grassland Buffer	Upland Forest Buffer
Wetland A	None	None	None	None
Wetland B/ Unnamed Creek	0.26 – potential loss of wetland or habitat change due to relocation of stream.	None	None	None
Wetlands C and D/228th Street Creek, Channel A	0.85 –restoration/ enhancement activities in this wetland/stream complex.	1.01	1.20 – grassland converted to forested and shrub riparian and/or wetland habitat	0.33 – some tree removal for stream relocation.
Wetland E	0.14 of open water and 0.25 of riparian shrub –filled during construction and relocated to the north.	Added to Little Bear Creek buffers (see below).	None	None
Offsite wetland	0.1	0.1	None	0.06
Wetland E – 150-foot buffer/Little Bear Creek	See above under Wetland E.	2.0 - developed buffers converted to new vegetated stormwater treatment facilities.	See above for Wetlands C and D.	See above for Wetlands C and D.
Wetland E – 300-foot buffer/Little Bear Creek	See above under Wetland E.	5.9 - developed buffers converted to new vegetated stormwater treatment facilities.	See above for Wetlands C and D.	None
Howell Creek	Daylighted and relocated.	None	None	None

Howell Creek, combined with watercourses on the south portion of the site, would be restored to create usable fish habitat near the southern site boundary. The existing culvert under SR-9 at Howell Creek that blocks fish passage upstream would be replaced with a fish passable culvert designed for new stream flows.

Unnamed Creek would be daylighted and relocated to the south where it would flow through the wetland/stream mitigation area and through a fish passable culvert to Little Bear Creek.

The Little Bear Creek 150-foot stream buffer primary association area (defined by Snohomish County as use of a habitat area by a critical species for rearing young, roosting, breeding, or foraging on a regular basis during the appropriate season) for Puget Sound chinook salmon and 300-foot management zone extend across SR-9 onto the developed portion of the Route 9 site. As per Snohomish County Code, new "effective impervious surface" area must be limited within the primary association and management zones. However, these portions of the Little Bear Creek "riparian zone" are currently separated from the stream by SR-9 and do not provide riparian functions as would be provided by a vegetated buffer continuous with the stream. In these buffer areas, existing impervious surfaces would be replaced first by temporary construction stormwater treatment facilities and then by a permanent, decentralized stormwater treatment system that would provide both detention and water quality treatment. Although water quality improvement functions would increase in these buffer areas with the installation of the proposed vegetated stormwater ponds, SR-9 would continue to separate the treatment plant and its facilities from Little Bear Creek.

Stormwater management facilities located along the west side of the developed portion of the site would be used during construction to control fluctuating stormwater flows and to prevent sediments and pollutants from entering adjacent wetlands or streams (see Appendix 6-C, Management of Water Quality During Construction at the Treatment Plant Sites).

Prior to construction, surface water flowing through streams and watercourses on the site would be diverted around the construction site to mitigation areas on the north and south portions of the site or to a temporary diversion area. Aquatic habitats would be temporarily displaced during stream relocations.

Dewatering activities could temporarily impact stream and wetland systems, and aquatic species inhabiting them, on the Route 9 site. If unmitigated, the potential exists for dewatering activities to temporarily lower water tables in onsite wetlands during dewatering activities (Chapter 6, Figure 6-11). Some groundwater drawdown impacts to wetlands on the north portion of the site could be permanent. Wetlands and streams could be monitored during and after construction dewatering, and clean groundwater could be routed directly to wetlands and swales to help maintain water tables and minimize impacts to aquatic habitats. However, most of the existing wetlands on the site are largely formed in perched water tables that should not be affected during construction. As described in Appendix 6-B, Geology and Groundwater, turbid groundwater collected during dewatering would be treated to reduce turbidity and potential impacts to aquatic species before it is released to Little Bear Creek. Over the long term, the net change in flow to Little Bear Creek and resulting impacts to aquatic species due to dewatering is anticipated to be negligible (refer to Chapter 6). Groundwater at the Route 9 site has a low dissolved oxygen content and would be aerated prior to discharge to Little Bear Creek (see Appendix 6-C, Management of Water Quality During Construction at the Treatment Plant Sites).

Operation Impacts: Route 9 Treatment Plant

No significant negative impacts to onsite and adjacent upland habitats, wetlands, and streams or to fish and wildlife species are anticipated as a result of treatment plant operations. Noise and human activity may negatively affect sensitive wildlife species' use of onsite and adjacent habitats. Noise and activity levels at the Route 9 site are not expected to change significantly given existing industrialized conditions. However, nighttime noise would increase because the wastewater facilities would operate 24 hours per day. Native landscaping on the developed portion of the site would provide additional habitat for some native species. Habitat restoration and stream relocations are discussed under construction impacts.

The operation of the facility and the site mitigation measures are expected to improve fish habitat over existing conditions both on the site and in Little Bear Creek. Under current conditions, stormwater runoff from the Route 9 site is mostly untreated and the watercourses carry sediment and other pollutants into Little Bear Creek. The treatment plant's decentralized low-impact development (LID) stormwater management system should improve the water quality and reduce peak flows of stormwater from the site (see Appendix 6-D, Permanent Stormwater Management at the Treatment Plant Sites). Higher water temperatures resulting from the stormwater facilities are likely to occur but would be minimized with special measures to minimize solar heating and warming of stormwater (see Appendix 6-J, Summer Season Temperature Effects of Stormwater Ponds on Receiving Streams). Onsite streams and watercourses would be relocated and directed to vegetated stream/wetland restoration areas, which should provide cleaner, cooler water to Little Bear Creek that would benefit fish.

The Route 9 treatment plant system has one other flow management strategy that could be implemented before overflows to the Sammamish River would occur, as described under Operation Impacts Common to All Systems: Conveyance. Rather than discharging wastewater from the safety relief point into the Sammamish River after all available storage is filled, up to 170 mgd of dilute untreated wastewater would bypass the treatment processes at the plant site and flow into the effluent conveyance system for eventual discharge into Puget Sound. The goal of this strategy is to force the overflow to occur in a highly mixed marine environment rather than into an urban freshwater body, and thereby lessen the potential impact of such an event. This strategy would only be implemented if both primary and secondary power feeds were de-energized, the treatment plant was operating on standby power, the previous three flow management strategies were fully utilized, and an overflow was still imminent. No impacts to Little Bear Creek or onsite and adjacent wetlands are expected from emergency overflows.

Proposed Mitigation: Route 9 Treatment Plant

Site mitigation for impacts to existing onsite and offsite wetlands and streams includes two main wetland/stream mitigation areas, the use of LID measures, and a decentralized stormwater management system. Mitigation areas on the north and south portions of the Route 9 site are being designed to improve fish and wildlife habitat. Streams and

watercourses would be daylighted and relocated to the mitigation areas, and culverts would be removed or replaced to provide fish passage.

Upland Habitat Mitigation

Upland grassland and some upland forest areas would be converted to wetland-riparian habitats where streams are being relocated. Mitigation measures in upland habitats include the following:

- Minimizing the removal of large trees
- Retaining any large woody debris onsite for use in stream relocations and enhancement
- Removing fill soils and/or amending disturbed soils with compost or topsoil in mitigation areas before planting
- Replanting disturbed areas with native vegetation
- Enhancing new stream and wetland buffer areas with native plantings to increase species diversity

Special Status Species Mitigation

- Mitigation measures are expected to improve habitat for several special status wildlife species over time as trees in mitigation areas mature, and new stream channels and ponds become established. The species most likely to benefit from mitigation measures include the pileated woodpecker, bat species, Puget Sound chinook salmon, and coho salmon.
- Fish species are also likely to benefit from increased functions and improved stream features resulting from mitigation measures such as water quality improvement, stormwater management, erosion control, shading, woody debris, and food sources.

Wetlands and Fish Habitat Mitigation

- Two mitigation areas are proposed at the north and south ends of the site to compensate for alterations to streams, wetlands, and watercourses and their buffers. Unnamed Creek relocated in the area north of the treatment plant and Howell Creek relocated south of the treatment plant. In these areas, new vegetated sinuous stream channels would be created to enhance existing habitat conditions. Small ponds and wetlands would also be created in the north end of the site to mitigate for impacts to Wetland E. The final mitigation for these sites may include the removal of fill soils, application of soil amendments, the creation of new microhabitats, and restoration with native trees, shrubs, and herbs. These mitigation areas should provide habitat to a greater diversity of native wildlife

species and would provide additional and highly improved spawning and rearing habitat for salmonids that use the Little Bear Creek system.

- Where fish are present, in-water work would be restricted to WDFW in-water work windows for fish.
- Final mitigation measures for impacts from stream daylighting/relocations to wetlands and streams would be negotiated with federal, state, and Snohomish County permitting agencies and would meet their mitigation requirements. Impacts to wetlands and stream have been avoided and minimized to the extent possible and are limited to the impacts that are needed for success of the stream and watercourse relocation and daylighting. The functions and values of relocated streams and wetlands would be replaced at more than a 1:1 ratio to compensate for the temporary loss of functions and values during construction and while wetland/stream relocations are in process.
- Mitigation measures for stormwater treatment during construction and operation and dewatering during construction are discussed in more detail in Chapter 6.

7.3.2.2 Conveyance: Route 9

Construction Impacts: Route 9–195th Street Corridor

Connection to the Existing Wastewater System

The impacts of constructing connections to the existing wastewater system are discussed under Impacts and Mitigation Common to All Systems: Conveyance Corridors, Construction Impacts.

Primary Portal Siting Areas

Five primary portals (Portals 11, 41, 44, 5, and 19) are proposed for the 195th Street corridor. Table 7-18 presents potential construction impacts for all primary candidate portal sites for the 195th Street corridor, including impacts to known wetlands, streams, buffers, mature upland forest, or special status species on or adjacent to the sites. Potential impacts are based on the minimum size of the site necessary for construction of the portal. Tunnel boring machine (TBM) launching portals (Portals 11, 41, 44, and 19) would need a minimum of 2 acres, whereas TBM receiving portals (Portal 5) would need a minimum of 1 acre. Portal 41 would need 2 acres for launching and an additional 2 acres for potential construction of a pump station, for a total of up to 4 acres, as discussed under the Portal 41 IPS option below.

Groundwater inflow during construction of Primary Portal 41 would lower the groundwater table between 1 and 2 feet within a 500-foot radius of the selected candidate portal site (see Chapter 6). Construction at candidate Portal Sites A, C, J, W, and X would decrease the groundwater elevation in wetlands (AR 52, AR 53, AR 61a, AR 110, AR 130, and AR 155) on or adjacent to the sites. If unmitigated, the groundwater elevation in these wetlands could be lowered enough to resemble upland hydrology, which could adversely affect the survival of wetland vegetation. In addition, construction of candidate Portal Site A would decrease flows in North Creek (AR 61b) by drawing groundwater away from the stream. Construction of candidate Portal Sites J and D would decrease flows and/or the water elevation in a stormwater drainage canal (AR 52a) adjacent to these sites. Existing groundwater elevations and surface water conditions would be restored after portal construction. Six months is the expected construction duration for Portal 41.

Above-ground permanent odor control facilities with electrical rooms would be constructed at Portals 11, 5, and 44. The odor control facility at Portal 5 would also include an air handling facility. A dechlorination facility would also be constructed at Portal 5. Odor control and dechlorination facilities would be constructed within the area previously disturbed for portal construction and would not require any additional clearing outside of the portal construction footprint. Minimal to no dewatering is anticipated for construction of above-ground facilities because portal shafts would be sealed prior to construction.

Table 7-18. Potential Construction Impacts to Aquatic Resources, Buffers, Mature Upland Forest, and Special Status Species on or Adjacent to Primary Candidate Portal Sites on the Route 9–195th Street Corridor

Portal Siting Area	Candidate Portal Site	Aquatic Resource Number[a]	Name or Type	Local Buffer Width (feet)	Wetland Impact (acres)	Wetland and/or Stream Buffer Impact (acres)	Mature Upland Forest Impact (acres)	Potential Stream Diversion Impact	Total Wetland, Buffer, and Mature Upland Forest Impact (acres)	Potentially Impacted Special Status Species (documented species)	Nature of Potential Impact
11	A, B, and C	--	--	--	--	--	--	--	--	Bald eagle	Potential construction noise.
44	C	67c	Tributaries to Little Swamp Creek	100	--	1.09	--	Yes	2.13	Coho salmon	Potential impact to two headwater tributaries to Little Swamp Creek.
		57a	Wetland	50	1.04		--	--		--	Potential impact to narrow riparian wetlands dominated by herbs and immature shrubs.
	D	57c	Wetland	50	0.05	0.38	--	--	0.43	Coho salmon	Potential impact to narrow riparian wetland and previously disturbed buffers.
		67c	Little Swamp Creek	100	--		--	Yes			Longer culvert necessary for a construction entrance.
	E	58	Wetland	50	0.39	0.98	--	--	1.37	--	Potential impact to forested wetland located between two residences. Impact to wetland buffer occupied by a residence and landscaped vegetation.
41	A, C, D, J, and X	--	--	--	--	--	--	--	--	--	No direct impacts anticipated.
	W	155	Wetland	50	0.47	0.90	--	--	1.37	--	Potential impact to disturbed wetland and wetland buffer.
19	A	138	Stream	75	--		--	Yes		--	Potential impact to a small tributary to Puget Sound. Impact to stream buffer vegetated with red alder, big-leaf maple, Indian plum, Himalayan blackberry, salmonberry, trailing blackberry, water parsley, and lady fern.

[a] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.

Table 7-18. Potential Construction Impacts to Aquatic Resources, Buffers, Mature Upland Forest, and Special Status Species on or Adjacent to Primary Candidate Portal Sites on the Route 9–195th Street Corridor (cont.)

Portal Siting Area	Candidate Portal Site	Aquatic Resource Number[a]	Name or Type	Local Buffer Width (feet)	Wetland Impact (acres)	Wetland and/or Stream Buffer Impact (acres)	Mature Upland Forest Impact (acres)	Potential Stream Diversion Impact	Total Wetland, Buffer, and Mature Upland Forest Impact (acres)	Potentially Impacted Special Status Species (documented species)	Nature of Potential Impact
19 (cont.)	A (cont.)	139	Wetland	50	0.18	0.99	--	--	1.17	Bald Eagle	Potential impact to a small scrub-shrub sloped wetland dominated by Pacific and Sitka willows, red alder saplings, and reed canarygrass. Impact to wetland buffer dominated by invasive reed canarygrass and Himalayan blackberry. Construction noise.
	C	154	Wetland	25	--	0.09	--	--	0.09	Bald Eagle	Potential impact to small emergent wetland. Construction noise.
	E	--	--	--	--	--	--	--	--	Bald Eagle	Potential construction noise.
5	B, G, and X	--	--	--	--	--	--	--	--	--	No impacts anticipated.

[a] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.

Secondary Portal Siting Areas

Four secondary portals (Portals 45, 7, 27, and 23) are potentially proposed for the 195th Street corridor, although not expected to be used. Table 7-19 presents potential construction impacts from these portals, including impacts to known wetlands, streams, buffers, mature upland forest, or special status species on or adjacent to the sites. The maximum size of a site for construction of a secondary portal site would be 0.5 acres.

Portal 41 Influent Pump Station Option

Under the Portal 41 Influent Pump Station (IPS) option, facilities would include a pump station, an odor control facility, a standby power building, and an electrical substation. With the exception of the pump station, facilities would be constructed within the previously disturbed portal footprint. An estimated additional 2 acres outside the developed footprint would be necessary for construction of the IPS at Portal 41, resulting in a corresponding increase of vegetation and habitat removal on the selected site. This would include vegetation clearing and grading, erosion and sedimentation, accidental and incidental discharge of pollutants, and increased noise and lighting levels. Construction of underground facilities associated with the IPS would require dewatering in addition to dewatering necessary for portal construction.

Constructing the IPS at Portal 41 instead of at the Route 9 site would add approximately 2 additional acres of existing highly disturbed area at the treatment plant site that could be used for revegetation and restoration of habitat.

Operation Impacts: Route 9–195th Street Corridor

Primary Portal Siting Areas

Operation impacts at portal sites would largely relate to the potential for spills of chemicals used for odor control or dechlorination. The risk of a sodium bisulfite spill at the dechlorination facility (Portal 5) or during transport to the facility is considered low. Likewise, the risk of odor control chemical spills at the odor control facilities (Portals 11, 41, 5, and 44) or during transport to the facilities is also considered low. There have been no documented incidences of spills at any King County wastewater facility that migrated offsite and resulted in impacts to the environment. Chemical handling and containment procedures are discussed in more detail in Chapter 9. Though highly unlikely to occur, it is possible that a significant discharge of sodium bisulfite or other chemical to a stream could be lethal to fish by reducing dissolved oxygen levels. None of the candidate sites for Portal Siting Area 5, however, have wetlands or streams on or directly adjacent to the site, which would minimize the potential for spills from reaching surface waters. Harmful spills would be avoided with implementation of proposed mitigation measures (see following section).

Table 7-19. Potential Construction Impacts to Aquatic Resources, Buffers, Mature Upland Forest, and Special Status Species on or Adjacent to Secondary Candidate Portal Sites on the Route 9–195th Street Corridor

Portal Siting Area	Candidate Portal Site	Aquatic Resource Number[a]	Name or Type	Local Buffer Width (feet)	Wetland Impact (acres)	Wetland and/or Stream Buffer Impact (acres)	Mature Upland Forest Impact (acres)	Potential Stream Diversion Impact	Total Wetland, Buffer, and Mature Upland Forest Impact (acres)	Potentially Impacted Special Status Species (documented species)	Nature of Potential Impact
45	A, C, and D	--	--	--	--	--	--	--	--	--	No impacts anticipated.
7	A, B, and C	--	--	--	--	--	--	--	--	--	No impacts anticipated.
27	A	---	--	--	--	--	--	--	--	--	No impacts anticipated.
	B	141	Wetland	100	--	0.43	--	--	0.43	--	Potential impact to herbaceous wetland buffer dominated by invasive reed canarygrass and upland grasses.
	C	--	--	--	--	--	--	--	--	--	No impacts anticipated
23	A, D, and F	--	--	--	--	--	--	--	--	--	No impacts anticipated.

[a] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.

Secondary Portal Siting Areas

Permanent facilities are not anticipated at secondary portals. Therefore, operation impacts are not anticipated.

Portal 41 Influent Pump Station Option

Potential operational impacts associated with the pump station at Portal 41, including increased stormwater runoff and increased noise, light, and human activity, would be similar in nature and magnitude to the impacts associated with other proposed above-ground facilities at portals. However, the magnitude would be less compared to impacts associated with treatment plant sites because the pump station facility would be smaller in size.

Operation impacts would be similar to those described above for the use of chemicals at odor control or dechlorination facilities at the primary portals. Potential impacts from spills or leaks of stored chemicals onsite would be low, similar to those described for the treatment plant site. Quantities and types of materials used at the pump station site would be lower.

Activities at Portal 41 associated with influent pump station operation could contribute to increased noise levels. Similar to treatment plant operation impacts, operations noise may reduce the number of noise-sensitive animals that currently use habitats near the site.

Because of in-line storage associated with this option, the risk of discharge from the safety relief point would increase under this option, as compared to the proposed project. While the potential for discharge is still very low, the frequency could increase to as much as one event every 50 to 75 years. This increased risk still represents a significant improvement over existing discharge frequencies.

Proposed Mitigation: Route 9–195th Street Corridor

Ensuring that contractors who deliver the chemicals are trained and have a spill control plan would minimize the risk of a spill during transportation. In addition, state and federal laws would be followed that relate to transportation, handling, and storage of hazardous chemicals. Refer to Chapter 9 for more information. Once the chemicals are safely within storage tanks at the facilities, risk of a spill would be minimal because of safety controls such as double walls and spill containment berms. If a spill were to occur, it would be conveyed to a drain that enters the sanitary sewer system to prevent offsite impacts.

Construction Impacts: Route 9–228th Street Corridor

Connection to the Existing Wastewater System

The impacts of constructing connections to the existing wastewater system are discussed under Impacts and Mitigation Common to All Systems, Conveyance Corridors, Construction Impacts.

Primary Portal Siting Areas

In addition to the influent corridor portals in common with the 195th Street corridor (Portals 11, 44, and 41) four primary portals (Portals 39, 33, 26, and 19) are proposed for the 228th Street corridor. Table 7-20 presents potential construction impacts to known wetlands, streams, buffers, mature upland forest, and special status species on or adjacent to primary candidate portal sites. Potential impacts are based on the minimum size of the site necessary for construction of the portal. Tunnel boring machine (TBM) launching portals (Portals 11, 44, 41, 39, 33, and 19) would need a minimum of 2 acres, whereas TBM receiving portals (Portal 26) would need a minimum of 1 acre. Portal 41 would need 2 acres for launching and an additional 2 acres for the potential construction of a pump station, for a total of up to 4 acres under the Portal 41 IPS option (discussed below).

Above-ground permanent facilities for the 228th Street influent corridor would be at the same locations (Portals 11, 41, and 44) and of the same size as those described for the 195th Street influent corridor. In addition, an odor control facility and a dechlorination facility would be located at Portal 26. Construction of the above-ground permanent facilities would have the same potential temporary construction impacts associated with the construction of a portal (e.g., erosion and sedimentation, accidental and incidental discharge of pollutants, and increased noise and lighting levels), with the exception that there would be little or no removal and discharge of dewatering water. Odor control and dechlorination facilities would be constructed within the same area previously disturbed for portal construction and would not require any additional clearing outside of the portal construction footprint.

Impacts from dewatering activities for construction at Portal 41 would be the same as those described previously for the Route 9 – 195th Street corridor.

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Table 7-20. Potential Construction Impacts to Aquatic Resources, Buffers, Mature Upland Forest, and Special Status Species on or Adjacent to Primary Candidate Portal Sites on the Route 9–228th Street Corridor

Portal Siting Area	Candidate Portal Site	Aquatic Resource Number[a]	Name or Type	Local Buffer Width (feet)	Wetland Impact (acres)	Wetland and/or Stream Buffer Impact (acres)	Mature Upland Forest Impact (acres)	Stream Diversion Impact (linear feet)	Total Wetland, Buffer, and Mature Upland Forest Impact (acres)	Potentially Impacted Special Status Species (documented species)	Nature of Potential Impact
11 44 41							See Table 7-18.				
39	B	--	Mature forest	--	--	--	0.71	--	0.71	--	Potential impact to mature deciduous forest dominated by black cottonwood and red alder.
	C,D	--	--	--	--	--	--	--	--	--	No impacts anticipated.
33	A	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	C	--	--	--	--	--	--	--	--	--	No impacts anticipated
	D	67a	West fork of Swamp Creek	200	--	1.28	--	--	1.28	chinook salmon, Coho salmon, sockeye salmon	Potential impact to stream buffer dominated by landscaped vegetation (e.g., lawn and shrubs) and occasional black cottonwood, red alder, Indian plum, and common hawthorn.
26	A	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	C	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	D	--	Mature forest	--	--	--	0.45	--	0.45	--	Potential impact to mature coniferous forest dominated by western red cedar, western white pine, Douglas fir, western hemlock, red alder, and Pacific madrone.
19							See Table 7-18.				

[a] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.

Secondary Portal Siting Areas

Four secondary portals (Portals 37, 30, 24, 22) are potentially proposed for the 228th Street corridor. Table 7-21 presents information on impacts of secondary candidate portal sites to known wetlands, streams, buffers, mature upland forest, and special status species on or adjacent to the sites. The maximum size of a site for construction of a secondary portal site would be 0.5 acres.

Portal 41 Influent Pump Station Option

Construction impacts associated with the influent pump station option at Portal 41 would be the same as those discussed under the 195th Street corridor above.

Operation Impacts: Route 9–228th Street Corridor

Primary Portal Siting Areas

Operation impacts for the 228th Street corridor associated with the risk of chemical spills would be the same as those described for the 195th Street corridor. Two candidate portal sites for Portal Siting Area 26 are adjacent to Hall Creek. This location increases the risk of a spill affecting fish and other aquatic life in the unlikely event such a spill occurs.

Secondary Portal Siting Areas

Permanent facilities are not anticipated at secondary portals. Therefore, operation impacts are not anticipated.

Portal 41 Influent Pump Station Option

Operation impacts associated with the influent pump station option at Portal 41 would be the same as those discussed under the 195th Street corridor above.

Proposed Mitigation: Route 9–228th Street Corridor

Mitigation measures associated with chemical handling and storage for the dechlorination and odor control facilities along the 228th Street corridor are the same as those described for the 195th Street corridor.

Table 7-21. Potential Construction Impacts to Aquatic Resources, Buffers, Mature Upland Forest, and Special Status Species on or Adjacent to Secondary Candidate Portal Sites on the Route 9–228th Street Corridor

Portal Siting Area	Candidate Portal Site	Aquatic Resource Number[a]	Name or Type	Local Buffer Width (feet)	Wetland Impact (acres)	Wetland and/or Stream Buffer Impact (acres)	Mature Upland Forest Impact (acres)	Stream Diversion Impact (linear feet)	Total Wetland, Buffer, and Mature Upland Forest Impact (acres)	Potentially Impacted Special Status Species (documented species)	Nature of Potential Impact
37	A, C, and D	--	--	--	--	--	--	--	--	--	No impacts anticipated.
30	A	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	B	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	C	--	Mature forest	--	--	--	0.43	--	0.43	--	Potential impact to mature coniferous forest dominated by Douglas fir and western red cedar.
24	A, B, and C	--	--	--	--	--	--	--	--	--	No impacts anticipated.
22	A, C, D, E, F										No impacts anticipated.

[a] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.

7.3.2.3 Outfall: Route 9

Construction Impacts: Route 9 Outfall

The nature of impacts from outfall construction would be the same as those described above under Impacts and Mitigation Common to All Systems. Construction would result in impacts to a variety of habitat types and to marine plants and animals. Highly mobile species would move away from the construction area, while less mobile species would be displaced. Table 7-22 provides approximate impact area by habitat type for the Route 9 outfall system.

Table 7-22. Approximate Impacts From Outfall Construction to Habitat in Zone 7S

Habitat Type	Approximate Area of Impact	Summary of Habitat Impacts
Shoreline/riparian	11,000 square feet	Removal of trees, shrubs. Disruption of forage fish spawning habitat.
Intertidal/shallow subtidal	27,000 to 45,000 square feet	Removal of sea lettuce, eelgrass, and associated marine organisms.
Deep subtidal	~ 5,000 linear feet	Placement of hard substrate (the pipeline) on the seabed.

During construction of the outfall in Zone 7S, eelgrass would be removed from approximately –1.5 feet MLLW down to approximately the -15-foot depth contour during in-water trenching activities. It is estimated that approximately 7,000 shoots of eelgrass would be disturbed during construction. Overall, this alignment offers the better opportunity, compared to Zone 6, to minimize and avoid impacts to sensitive eelgrass communities. The alignment in Zone 7S has lower eelgrass density, both overall and within specific patches, compared to Zone 6. Eelgrass density is also lower along the trench (approximately 7 shoots per square meter) that would be required to construct the proposed alignment. The amount of eelgrass disturbed in Zone 7S would be approximately one-third of the amount disturbed for outfall construction in Zone 6.

Sea lettuce may also be removed during in-water open cut construction activities depending on where the outfall is placed in the zone. The outfall would be located to avoid any removal of kelp in this zone.

Operation Impacts: Route 9 Outfall

Operation impacts are the same as those listed earlier under Impacts and Mitigation Common to All Systems.

Proposed Mitigation: Route 9 Outfall

The preferred outfall alignment in Zone 7S was selected, in part, because it has the shortest possible nearshore segment and would therefore minimize effects on plants and animals in the sensitive nearshore habitat.

Mitigation measures are the same as those listed earlier under Impacts and Mitigation Common to All Systems.

7.3.3 Impacts and Mitigation: Unocal System

7.3.3.1 Treatment Plant: Unocal

Construction Impacts: Unocal Treatment Plant

Construction impacts at the Unocal site are expected to be similar in nature for the Unocal 36-mgd/54-mgd alternative and for the 72-mgd sub-alternative, as well as for the structural lid sub-alternative. The extent of the construction area and resultant impacts would be greatest for the 72-mgd plant and lowest for the 36-mgd plant. The plant footprints for the 36-mgd, 54-mgd, and 72-mgd plants would cover 30, 32, and 34 acres, respectively. Most of upland forest and shrub habitats would be lost and a small amount of wetland area would be impacted on the Unocal site (Table 7-23 and Figure 7-32). The analyses of impacts to wetlands and streams are more refined than those described in the Draft EIS as the result of more specific site planning conducted since issuance of the Draft EIS.

Upland Habitat

Most of the 15 acres of upland forest habitat (including the forested slope adjacent to Puget Sound and to the former Unocal tanks) would be removed for all plant configurations at the Unocal site. Removal of this habitat would further fragment remaining vegetated habitats and wildlife linkages present in the shoreline area. For the 36-mgd and 54-mgd plants, approximately 12 acres of upland forest would be permanently removed (Figure 7-32). The 72-mgd plant would permanently remove approximately 14 acres of upland forest (Figure 7-33). The permanent loss of native forest habitat would result in a loss of mature trees, potential nest sites for birds, burrows for ground-dwelling mammals, roost sites for bats and birds, and foraging and cover sites for amphibians, reptiles, birds, and mammals.

Table 7-23. Potential Habitat Loss (acres) or Changes on the Unocal Site

Habitat Type	Habitat Loss 54-mgd/72-mgd	Common Species Affected	Special Status Species Affected
Upland forest	12.42/13.75[a]	Mountain beaver, black-tailed deer, numerous song birds, raptors, and other forest-related species.	Virtually all special status species would be affected in some way, especially, great blue heron, bald eagle, red-tailed hawk, and bats.
Upland shrub	0.37[a]	Shrub nesting song birds such as white crowned sparrow, song sparrow, and American robin would lose nesting habitat.	Not currently providing significant habitat for special status species.
Forested/ shrub-scrub wetland and riparian	0.02/0.47 plus riparian buffer impacts shown in Table 7-24.	Habitat enhancement may increase the diversity and abundance of warblers, flycatchers, and other birds.	Willow Creek daylighting/restoration should increase habitat available for coho salmon, and foraging for great blue heron and bald eagle.
Salt marsh	No habitat loss. Dewatering may result in minor temporary changes in wetland hydrology or salinity.	Aquatic species such as mollusks, insects, fish, and waterfowl may be affected by small changes in wetland hydrology or salinity.	Coho salmon may be affected by small changes in wetland hydrology or salinity.
Emergent wetland	Same as for salt marsh.	Same as for salt marsh.	No effects anticipated.
Open water	No habitat changes anticipated.	None	None
Marine nearshore	Temporary impacts during outfall construction.	Shorebirds, fish, waterfowl	Great blue heron, coho and chinook salmon, bald eagle

[a] Includes impacted wetland/stream buffer areas.

Species most likely to be affected by construction include but are not limited to mountain beaver, pileated woodpecker, red-breasted nuthatch, black-capped chickadee, song sparrow, American robin, big brown bat, little brown bat, vole, mouse, shrew, and common garter snake. Ground-dwelling species such as the mountain beaver, shrew, vole, and garter snake are likely to face direct mortality during construction. Others are likely to be forced into adjacent areas in and near the Edmonds Marsh, where they may or may not find suitable and available habitat for breeding or foraging. Depending on the timing of site clearing, bird nests, eggs, or young or mammal young may be destroyed.

In remaining upland habitats on the northeast portion of the site, species that may be temporarily affected by construction noise and activities include songbirds, mammals and amphibians.

Approximately 4 miles of new 115 kV electrical line would be required for the Unocal site. This would include 2 miles of new line from the Westgate substation along Edmonds Way, and 2 miles from the Five Corners substation along Walnut Street to the plant site. Lines would be installed underground in trenches approximately 5.5 feet deep and 3 feet wide. Vaults measuring 12 feet by 10 feet by 5.5 feet deep would be constructed approximately every 1,000 feet. Where not located in developed right-of-way, construction could result in removal of vegetation and impacts to upland habitat. Energy for the plant cogeneration facility may also require construction of 3.5 miles of new high-pressure gas line from 72nd Avenue West and 212th Street to the site. Construction of this line may similarly entail some vegetation clearing and impacts to upland habitat, however, because facilities would largely be located in developed areas, impacts to plants and animals are not expected to be significant. As the form and location of specific energy facilities is determined in the design process, appropriate additional environmental review will be conducted as needed.

Special Status Species

The loss of forest habitat would result in the loss of important habitat elements for special status species:

- Roosting, perch, and potential nesting sites for great blue heron, bald eagle, pileated woodpecker, osprey, Vaux's swift, and merlin
- Roost sites for bats such as Keen's myotis, long-eared, and long-legged myotis
- Foraging opportunities and cover for all of these species

Trees formerly used by great blue heron for nesting in 1996-1997 would be removed. Tree perch sites and suboptimal nest sites for the bald eagle and osprey adjacent to Puget Sound would also be removed.

Increased noise levels caused by pile driving and other construction activities could change the behavior of and reduce the amount of usable habitat available for several of the special status bird and fish species in areas adjacent to the plant construction area, both on and offsite. Special status species that inhabit the Edmonds Marsh and Puget Sound shoreline habitats, such great blue heron, bald eagle, and Puget Sound chinook and coho salmon, are sensitive to and may avoid noisy construction areas (Feist et al. 1992; Watson and Pierce, 1998), as described earlier under Impacts and Mitigation Common to All Systems.

As previously noted, great blue herons have nested on the site in recent years, and they are not likely to return to the Edmonds Marsh area for nesting during the noisiest and most active construction period, which could last up to 4.5 years. They may also avoid foraging in the area during construction.

Bald eagle nests are located along Puget Sound approximately 1 mile north and 0.5 mile south of the Unocal site. Although these birds may avoid foraging and perching on the site or in the site vicinity during the construction period, nest success should not be

affected by construction. Even at the West Point Treatment Plan where the Discovery Park eagle nest was located 1,300 feet east of the nearest construction activities, eagles nested successfully each year during the seven-year construction period ending in 1996 (Parametrix, 1996). Pile driving activities would occur within 1 mile of the bald eagle nest south of the site; timing restrictions on this activity may be required to avoid disturbances to this nest site.

Pileated woodpecker, also known to forage on the site, may avoid nesting and foraging in adjacent habitats during construction. The great blue heron, bald eagle, and pileated woodpecker may return to available habitats adjacent to the site after construction has been completed, or as indicated by the results of the West Point Treatment monitoring these birds might not be significantly affected by construction.

Other special status species, though less likely to be present on the site, may use adjacent habitats, but may avoid these habitats during the construction period. Some of the species may return to habitats adjacent to the site after construction has been completed.

Wetlands and Fish Habitat

Construction activities would cause the loss of Wetland C and of buffer areas for Wetlands A, B, and Willow Creek. Wetland, stream, and buffer impacts are summarized in Table 7-24.

Table 7-24. Potential Impacts to Wetlands, Streams, and Buffer Areas on the Unocal Site

Wetland/ Stream	Impacts (acres)			
	Impacted Wetland/ Stream Area	Developed Buffer Impacted[a]	Upland Shrub Buffer Impacted	Upland Forest Buffer Impacted
Wetlands A and B and Willow Creek	0/0.45[b]	2.24[c]	0.14[c]	0.69/2.02[b]
Wetland C	0.02[c]	0.03[c]	0	0.10[c]

[a] The greater of the wetland or stream buffer was used to calculate buffer impacts.
[b] Impacts for 54-mgd plant/impacts for 72-mgd plant.
[c] Impacts for both 54-mgd and 72-mgd plants.

Direct impacts to the Edmonds Marsh (Wetland A) and Willow Creek, in terms of wetland loss and stream displacement, would be avoided for construction of the 54-mgd plant. The 72-mgd plant would require four more secondary clarifiers than the 54-mgd plant. Construction of these clarifiers would result in the permanent loss of 0.45 acre of forested and scrub-shrub wetland in Edmonds Marsh and possible relocation of a small portion of Willow Creek (Figure 7-33). However, these wetland and stream impacts could be avoided or minimized by optimizing the 72-mgd site layout and/or by using new treatment technologies that may be available in the future.

Construction of both the 54-mgd and 72-mgd Unocal plants would result in the permanent loss of a small, degraded, 0.02-acre scrub-shrub seep wetland (Wetland C) and its regulated 25-foot upland buffer, composed of 0.1 acre of forest and 0.03 acre of developed area (Table 7-24). These impacts would be unavoidable because the wetland is located on a slope that would be excavated during site construction. Birds, mammals, and amphibians that would be affected are similar to those found at the adjacent upland forest (see Upland Habitats above). The small wetland provides similar habitat to that of the surrounding forest, and also supplies a water source for these animals. This function as well as groundwater discharge at this location would be lost during construction.

A total of 0.83 acre of shrub and forested buffer for Wetlands A and B and Willow Creek would be lost during construction of the 54-mgd plant, and 2.0 acre would be lost for the 72-mgd plant (see Table 7-23 for upland shrub and upland forest habitats affected). However, similar to wetland and stream impacts discussed above, buffer impacts for the 72-mgd plant would be minimized by optimizing the site layout and/or by using future treatment technologies. Upland shrub impacted by construction is dominated by Scot's broom and provides limited buffer functions in terms of water quality treatment, shading/water temperature control, habitat, woody debris recruitment, and other functions. The loss of forested wetland and stream buffer would diminish buffer functions including water quality treatment, storm flow control, wildlife habitat, woody-debris contribution, and shading.

Approximately 2.24 acres of the Wetlands A and B and Willow Creek buffer areas to be affected by plant construction are currently developed. The loss of these gravel areas would have little effect on the wetlands and streams on the site, except for the lost opportunity of restoring the buffer to a vegetated condition.

Erosion and sedimentation may affect onsite and adjacent streams and wetlands due to the excavation required for construction, covering approximately 30, 32, and 34 acres for the 36-mgd, 54-mgd, and 72-mgd plants, respectively. Heavy earthwork activities are expected to span up to 2.5 years. The Edmonds Marsh (Wetland A), Wetland B, and Willow Creek and their buffers are located adjacent to construction activities.

Stormwater would be treated in a water quality treatment pond in the north corner of the site. Stormwater from this facility would flow directly to Puget Sound; therefore, no impacts to Edmonds Marsh, Wetland B, or Willow Creek are anticipated (Appendix 6-C, Management of Water Quality During Construction at the Treatment Plant Sites).

Measures to minimize groundwater drawdown and intrusion of saltwater, such as a cut-off wall between Edmonds Marsh and the construction site, are proposed to avoid direct impacts to the marsh (see Chapter 6). However, clean dewatering water would likely be used to maintain water levels in adjacent sensitive areas, including wetlands. Any change in water levels would be minimized to the extent possible. These changes, however, could result in salinity changes in the salt marsh and could affect aquatic organisms such as fish and insect larvae. Monitoring and other site-specific studies may be required by the permitting agencies to ensure that sensitive habitats are protected from the effects of even small water level changes. Aquatic breeding and foraging species, such as Pacific

chorus frog, cutthroat trout, coho salmon, sculpin, red-winged blackbird, song sparrow, common yellowthroat, great blue heron, mallard, Canada goose, American wigeon, American coot, muskrat, beaver, and others could be affected by changes in water chemistry and/or water level. Affected species may experience mortality or stress.

Construction noise, especially pile driving, and human activity may affect the behavior of fish and wildlife species. Juvenile salmonids may avoid marine nearshore areas near pile driving activities (Feist et al., 1992). Noises may interfere with songbird communication or cause birds to avoid foraging or nesting in the adjacent Edmonds Marsh area. Birds that may be affected include red-winged blackbird, common yellowthroat, song sparrow, mallard, American coot, great blue heron, bald eagle, Virginia rail, and marsh wren.

Operation Impacts: Unocal Treatment Plant

No significant adverse impacts to remaining onsite and adjacent upland habitats, wetlands, and streams or to fish and wildlife species are anticipated as a result of treatment plant operations.

Although operation activities would be limited to the developed portions of the site, noise, light, and human activity may affect noise sensitive wildlife species' use of remaining onsite and adjacent habitats.

Upland habitats, wetlands, and streams on and near the Unocal site are particularly sensitive to operation impacts due to their proximity to Puget Sound and the Edmonds Marsh, which provide habitat to a relatively diverse community of fish and wildlife species. Some species such as red-winged blackbird, common yellowthroat, western sandpiper, American coot, and muskrat are highly specialized and dependent on these fresh and saltwater habitats. Changes in the quality of these habitats could diminish their use by these species. However, the project has been designed to protect adjacent sensitive habitats and habitat mitigation would be required as part of project permitting.

Fish habitat conditions after construction at the Unocal site would be similar to existing conditions. Levels of contaminants in stormwater discharge to streams may be reduced compared to current conditions as the result of new stormwater treatment facilities and toxic substance remediation. This reduction in contaminants could potentially benefit fish in the streams, and fish habitat near the Deer Creek Hatchery may improve with cleaner runoff from the Unocal site.

Emergency discharges of untreated wastewater flows could occur under extreme conditions. Such discharges would occur only if both primary and secondary power feeds were de-energized, the treatment plant was operating on standby power, and the first three parts of King County's five-part emergency flow management program had been exhausted. These flows would be contained within a pipe and discharged directly to Puget Sound. Therefore, no effect on fish habitat in Willow or Shelleberger Creeks and onsite and adjacent wetlands is expected from emergency overflows. Potential impacts to marine flora and fauna are discussed under the Outfall section. Chapter 6 discusses the

potential short-term impacts of emergency overflows on the water quality of Puget Sound. Refer to Chapter 3 for a description of the emergency flow management approach for the Brightwater System.

Proposed Mitigation: Unocal Treatment Plant

- Mitigation would be implemented to comply with the City of Edmonds Development Code as well as state and federal requirements. Mitigation measures for construction and operation of the Unocal plant would include daylighting/relocating Willow Creek, enhancing and restoring wetland and buffer habitat in and adjacent to Wetland B, replacing the Willow Creek culvert beneath Pine Street, and restoring fish habitat near Pine Street.
- Temporary construction and permanent stormwater treatment would be provided to protect adjacent resources in Puget Sound. Water levels would be maintained in the adjacent Edmonds Marsh and Willow Creek during construction dewatering by using measures such as a combination of cutoff walls and supplemental watering with clean water from dewatering operations. The dewatering water would be treated, if needed, to remove remaining petroleum contaminants prior to release to the marsh. Water levels would be monitored on a regular basis during the construction period.

Uplands and Special Status Species

- Approximately 12 and 14 acres of forest habitat would be lost to construction of the 36/54-mgd and 72-mgd plants, respectively. Some protection of upland habitats is required in accordance with local wetland and stream buffer protection requirements that are described in detail below. Some functions lost from the upland forest may be replaced through restoration of degraded buffers and creation of forest habitat in these areas.
- No specific measures for protecting upland habitats or special status species are yet identified besides those listed under common mitigation measures, such as following WDFW and USFWS recommendations for protecting nesting species. Timing restrictions may be placed on pile driving activities because a known bald eagle nest is located within 1 mile of the pile driving activities that would occur on the Unocal site. Before construction, the site would be surveyed for the presence of special status species nesting activities, especially for great blue heron and bald eagle. Coordinating the protection of nest sites with WDFW for state status species and USFWS for federally listed species would be required if special status species are nesting on or near the site.

Wetlands and Fish Habitat

- According to the City of Edmonds Development Code (EDC), the loss of the 0.02-acre Wetland C would require approximately 0.025 acre of wetland

mitigation at a 1.25:1 mitigation ratio for impacts to a Class 3 wetland. For the 72-mgd plant, the loss of 0.45 acre of Edmonds Marsh (Wetland A) would require an exemption from the City, federal and state permits, and 2.7 acres of wetland mitigation at a 6:1 wetland mitigation ratio for impacts to a Class 1 wetland. However, wetland loss anticipated for the 72-mgd plant could be avoided or minimized by optimizing the 72-mgd site layout or by using new treatment technologies that may be available in the future. Mitigation for impacts to Wetlands A and C and their buffers could be achieved through restoration or enhancement of Wetland B (2.3 acres of highly degraded wetland that has been used for stormwater detention), reconnection of Wetlands A and B, and the conversion to wetland habitat of upland shrub (dominated by Scot's broom) and developed areas adjacent to Wetland B (Figure 7-33). Restoration of Wetland B would entail remediation of contaminants and restoration of the remaining portion of Wetland B and its buffer. A narrow forested buffer would be created between the developed site and the restored Wetland B and Edmonds Marsh to enhance wetland functions and to replace a small portion of the upland forest eliminated by construction of the treatment plant.

- Willow Creek would be daylighted and relocated southeast of the railroad tracks and conveyed below the tracks to an open channel to Puget Sound. In-water work would be restricted to the WDFW in-water work window for fish. The 72-mgd site layout would be optimized and/or new treatment technologies would be used to avoid impacts to other sections of Willow Creek.

Potential Mitigation: Unocal Treatment Plant

- The culvert under Pine Street at the east end of the site could be replaced with a fish-passable culvert, and in-stream and riparian habitat would be enhanced.

7.3.3.2 Conveyance: Unocal

Construction Impacts: Unocal Conveyance

Connections to the Existing Wastewater System

The impacts of constructing connections to the existing wastewater system are discussed under Impacts and Mitigation Common to All Systems: Conveyance Corridors, Construction Impacts.

Primary Portal Siting Areas

Four primary portals (Portals 14, 11, 7, and 3) are proposed for the Unocal corridor. There are no potential construction impacts to wetlands, streams, buffers, or mature upland forest (Table 7-25). Without necessary mitigation, construction noise could

Table 7-25. Potential Construction Impacts to Aquatic Resources, Buffers, Mature Upland Forest , and Special Status Species on or Adjacent to Primary Candidate Portal Sites on the Unocal Corridor

Portal Siting Area	Candidate Portal Site	Aquatic Resource Number[a]	Name or Type	Local Buffer Width (feet)	Wetland Impact (acres)	Wetland and/or Stream Buffer Impact (acres)	Mature Upland Forest Impact (acres)	Stream Diversion Impact	Total Wetland, Buffer, and Mature Upland Forest Impact (acres)	Potentially Impacted Special Status Species (documented species)	Nature of Potential Impact
14	A	--	--	--	--	--	--	--	--	--	No impacts anticipated.
		--	--	--	--	--	--	--	--	--	No impacts anticipated
	B	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	D	--	--	--	--	--	--	--	-	--	No impacts anticipated.
11	See Table 7-18.										
7	See Table 7-19.										
3	D, E, and F	--	--	--	--	--	--	--	--	--	No impacts anticipated.

[a] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.

impact bald eagle activities in the vicinity of Portal 11. Potential impacts were assessed based on the minimum size of the site necessary for construction of the portal. Tunnel boring machine (TBM) launching portals (Portals 11 and 7) would need a minimum of 2 acres, whereas TBM receiving portals (Portals 24 and 3) would need a minimum of 1 acre. Portal 11 would need 2 acres for launching and an additional 2 acres for construction of a pump station, for a total for a total of up to 4 acres.

Groundwater inflow during construction of Primary Portal 14 would lower the groundwater table approximately 2 feet within a 500-foot radius of the portal site (see Chapter 6). Construction of candidate Portal Sites A, B, and D would decrease the groundwater elevation in wetlands (AR 52, AR 151) on or adjacent to the sites. If unmitigated, the groundwater elevation in these wetlands could be lowered enough to resemble upland hydrology, which could adversely affect the survival of wetland vegetation. In addition, construction of candidate Portal Sites A and B would decrease flows and/or the water elevation within a stormwater drainage canal (AR 52a) adjacent to these sites. Existing groundwater elevations and surface water conditions would be restored after portal construction. Construction for Portal 14 would last approximately one year.

Above-ground permanent odor control facilities with electrical rooms would be constructed at Portal 11 and Portal 7 . Permanent facilities would be constructed within the area previously disturbed for portal construction and would not require any additional clearing outside of the portal construction footprint. Construction of permanent facilities would have the same potential temporary construction impacts associated with the construction of a portal (e.g., erosion and sedimentation, accidental and incidental discharge of pollutants, and increased noise and lighting levels), with the exception that there would be minimal to no removal and discharge of dewatering water because portals would be sealed prior to construction of above-ground facilities.

Secondary Portal Siting Areas

Four secondary portals (Portals 12, 13, 10, and 5) are potentially proposed for the Unocal corridor, although not expected to be used. The only potential impacts to sensitive areas would occur at Portal 12, Site 12E (Table 7-26). The maximum size of a site for construction of a secondary portal site would be 0.5 acres.

Table 7-26. Potential Construction Impacts to Aquatic Resources, Buffers, Mature Upland Forest , and Special Status Species on or Adjacent to Secondary Candidate Portal Sites on the Unocal Corridor

Portal Siting Area	Candidate Portal Site	Aquatic Resource Number[a]	Name or Type	Local Buffer Width (feet)	Wetland Impact (acres)	Wetland and/or Stream Buffer Impact (acres)	Mature Upland Forest Impact (acres)	Stream Diversion Impact	Total Wetland, Buffer, and Mature Upland Forest Impact (acres)	Potentially Impacted Special Status Species (documented species)	Nature of Potential Impact
13	A	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	B	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	C	--	--	--	--	--	--	--	--	--	No impacts anticipated.
12	C	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	E	129	Wetland	100	0.17	0.33	--	--	0.50	--	Potential impact to pasture wetland and buffer.
10	A	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	C	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	D	--	--	--	--	--	--	--	--	--	No impacts anticipated.
	E	--	--	--	--	--	--	--	--	--	No impacts anticipated.
5	See Table 7-18.										

[a] Refers to wetlands, streams, and other aquatic resources shown on Figures 7-3 through 7-23.

Operation Impacts: Unocal Conveyance

Primary Portal Siting Areas

Operation impacts associated with the pump station at Portal Siting Area 11, including increased stormwater runoff and increased noise, light, and human activity, would be similar to the treatment plant sites; however, the magnitude would be less because the pump station would be smaller in size.

The risk of odor control chemical spills at the odor control facilities (Portals 11 and 7) or during transit to the facilities is considered low, similar to impacts associated with the 195th Street and 228th Street corridors. No dechlorination facilities would be required for portals associated with the Unocal system. There have been no documented incidences of spills at any King County wastewater facility that migrated offsite and resulted in impacts to the environment. Chemical handling and containment procedures are discussed in more detail in Chapter 9.

While unlikely, a significant discharge of chemicals to a stream could be lethal to fish by reducing dissolved oxygen levels. None of the candidate portal sites for Portal Siting Area 11, however, have wetlands or streams on or directly adjacent to the site. The lack of wetlands or streams would further minimize the potential for spills to reach surface waters. Spills are also unlikely with implementation of proposed mitigation measures (see below).

Secondary Portal Siting Areas

Permanent facilities are not anticipated at secondary portals. Therefore, operation impacts are not anticipated.

Proposed Mitigation: Unocal Conveyance

Risks of spills would be minimized though appropriate training of distributors and development of a spill response plan. In addition, state and federal laws would be followed that relate to transportation, handling, and storage of hazardous chemicals. Refer to Chapter 9 for more information. Once the chemicals are safely within facility storage tanks, risk of a spill would be minimal because of safety controls, such as double walls and spill containment berms. If a spill were to occur, it would be conveyed to a drain that enters the sanitary sewer system.

7.3.3.3 Outfall: Unocal

Construction Impacts: Unocal Outfall

The nature of impacts from outfall construction at the Unocal site would be the same as those described above under Impacts and Mitigation Common to All Systems. Construction would result in impacts to a variety of habitat types, and to marine plants and animals. Highly mobile species would move away from the construction area, while less mobile species would be displaced. Table 7-27 provides approximate impact area by habitat type for the Unocal System.

Table 7-27. Approximate Impacts From Outfall Construction to Habitat in Zone 6

Habitat Type	Approximate Area of Impact	Summary of Habitat Impacts
Shoreline/riparian	10,000 square feet	Removal of trees, shrubs. Disruption of forage fish spawning habitat.
Intertidal/shallow subtidal	51,000 to 85,000 square feet	Removal of sea lettuce, eelgrass, and associated marine organisms.
Deep subtidal	~ 5,000 linear feet	Placement of hard substrate (the pipeline) on the seabed.

Outfall construction would temporarily impact approximately 1 acre of the marine nearshore habitat on the portion of the site located west of the railroad tracks in and adjacent to Puget Sound. (Part of the impact would occur within developed areas of Marina Beach Park.) The 4.5-acre area where this construction would take place onshore currently consists of upland shrub and marine beach habitat that is disturbed by frequent human activity associated with Marina Beach Park (see Chapter 14). Individual marine and shorebirds, small mammals, and amphibians that may use the area may be displaced or experience mortality during the construction. During construction of the outfall in Zone 6, eelgrass would be removed from approximately +1.7 feet MLLW down to about the -1-foot depth contour during in-water trenching activities. It is estimated that approximately 23,000 shoots of eelgrass would be disturbed during construction. The alignment in Zone 6 has higher eelgrass density, both overall and within specific patches, compared to Zone 7S. Eelgrass density is also higher along the trench (approximately 18 shoots per square meter) that would be required to construct the proposed alignment.

Operation Impacts: Unocal Outfall

For the Unocal site, emergency overflows into Puget Sound, which would occur only after all other flow management options had been exhausted, would result in increased concentrations of bacteria, nutrients, and toxicants. State Water Quality Standards could be exceeded near the outfall for hours or, in the case of a prolonged power outage,

possibly days after the emergency overflow occurred; this would also temporarily impair marine habitat in the affected area.

Overflows would be discharged directly to Puget Sound through the deep water outfall for treated effluent. Impacts to terrestrial species are not expected to occur, except if contaminants wash up onshore. Emergency flows would be rapidly diluted into Puget Sound waters, minimizing the potential impacts. Impacts to aquatic habitats may include temporarily lowered dissolved oxygen levels, which would temporarily affect fish and aquatic organisms near the point of discharge. Fish and other mobile aquatic organisms would likely avoid the area of discharge. Because of its deep water location, discharges occurring during periods when juvenile fish are present in the nearshore Puget Sound would likely have minimal effects. Bivalves would likely close up if they came in contact with the untreated effluent.

Most contaminants would be broken down biologically or chemically or diluted, and water quality would return to a cleaner condition. However, some pollutants, such as heavy metals or those that do not break down in water, could be retained in sediments and may bioaccumulate in fish and other aquatic organisms, possibly having a long-term effect on their health and animals that forage on them. In the event of an emergency discharge to Puget Sound, King County would examine water quality in the vicinity of the discharge to assess and monitor for potential adverse impacts.

Proposed Mitigation: Unocal Outfall

Mitigation measures are the same as those listed earlier for Impacts and Mitigation Common to All Systems.

7.3.4 Impacts: No Action Alternative

Under the No Action alternative, wastewater flow increases that accompany the growing regional population would be routed to existing wastewater treatment plants and onsite disposal systems, including individual and group septic systems. As described in King County's 1998 Regional Wastewater Services Plan and Appendix 3-J, Evaluation of the No Action Alternative, existing King County wastewater system facilities are nearing capacity and will be unable to accommodate increased flows by 2010. This could result in increased overflows within the existing wastewater treatment system, including increased discharges of untreated wastewater into area streams, rivers, and lakes.

Overflows of untreated wastewater into Lake Washington, the Sammamish River, and other areas in the system (upland areas, marine waters, and the Green River) throughout the year could occur under this scenario. Currently, under rare occasions when the wastewater system becomes overloaded during and after heavy rain events, wastewater overflows into water bodies; the frequency of these events would increase in the future as capacities of current facilities reach maximum. When the wastewater system reaches capacity in approximately 2010, overflows could become a routine event. The results of a

1999 study of overflows concluded there was some potential for metals such as zinc and copper to exceed water quality criteria and for fecal coliform bacteria to occur at elevated concentrations in localized receiving waters (Seattle, 1999). It is unlikely, however, that these localized, periodic events, if they occurred over the next several years, would cause eutrophication problems in Lake Washington. (Eutrophication refers to an abundance of nutrients and productivity that can result in algal blooms and depleted oxygen.) If overflows were to become routine throughout the year, then eutrophic conditions, such as those that occurred in the 1950s, could occur again.

Untreated wastewater generally decreases dissolved oxygen and degrades water quality in receiving waters. Aquatic plant communities in receiving waters can change, and invasive plant species tend to thrive in degraded waters. Fish are affected by degraded water quality, and many aquatic organisms cannot live in degraded waters. If water quality and dissolved oxygen levels in the lake dropped below state Water Quality Standards, the migration, rearing, and reproduction of salmonid species could be negatively affected. Juvenile salmonids that are present in the area when an overflow occurs may experience mortality.

Fish and wildlife habitat on the proposed plant sites would continue to remain degraded by current activities. Although there are no current studies regarding fish and wildlife mortality and stress within the streams on or adjacent to the alternative wastewater treatment plant sites, current habitat conditions indicate that mortality and stress may continue or worsen over time, depending on future urban development. Current development plans for both sites, other than use as a treatment plant, could result in at least as much disturbance to fish, birds, and mammals as would result from a treatment plant.

7.3.5 Cumulative Impacts

Numerous construction-related projects are ongoing within the vicinity of the proposed Brightwater project, including residential and commercial development and road widening. The magnitude of losses to wetlands, streams, and wildlife habitat, while potentially not individually substantial, is increased when all of these projects are considered together. Despite requirements to revegetate disturbed areas and compensate for wetland and stream impacts, the cumulative effect of these projects would be a net decrease in wetland, stream, and wildlife habitats throughout the project area. While the treatment plant sites and portal sites proposed for this project would ultimately be restored where possible, replacement vegetation may require substantial growth time to provide the value of the habitat that was cleared, particularly for forested habitats and buffers.

Cumulative impacts to Puget Sound water quality from the construction and operation of the Brightwater treatment plant and outfall were evaluated to account for existing and possible future discharges and contaminant loadings to Puget Sound. If the proposed Edmonds Crossing multimodal facility proceeds as described in the Unocal System sub-alternative, additional in-water work that is required for that facility could cumulatively

add to impacts to marine resources associated with construction of the Brightwater outfall.

In the examination of potential impacts to surface water quality, King County added loadings from the Brightwater discharge to existing conditions in Puget Sound to examine cumulative impacts. This quantitative assessment is believed to be a reasonable approach because there are no known plans for additional point source discharges in the area and there are concentrated efforts in the region to improve the water quality of Puget Sound. King County and other municipal governments in the area are continuing efforts to increase the quality of their discharges in response to stricter regulatory requirements of the Endangered Species Act, Growth Management Act, and other environmental regulations. For example, there are planned improvements to combined sewer overflows and other capital improvement projects will have improved stormwater management infrastructure, which will reduce the loadings to Puget Sound. Similarly, King County is proposing to use membrane bioreactor treatment technology for the Brightwater System in an effort to minimize the loadings to Puget Sound. It is expected, therefore, that Puget Sound water quality will continue to improve over time and no additional water quality standard violations will occur due to discharges from the Brightwater treatment plant.

King County is committed to improving the water quality of Puget Sound through the improvement of existing infrastructure and the use of best available technology for new systems.

7.4 Significant Unavoidable Adverse Impacts

Treatment Plant

On the Route 9 site, three streams and six other watercourses would be rerouted to construct the treatment plant and to provide mitigation for wetland, stream, and buffer impacts. Impacts to wetlands and streams include the following:

- The loss of a 0.1-acre offsite wetland as the result of drainage pipe installation and retaining wall construction at the eastern edge of the site
- The relocation (temporary loss) of Wetland E (the fish rearing pond) and its associated riparian shrub habitat to the north
- A loss or change of wetland hydrology for Wetland B due to the relocation of Unnamed Creek to the south
- The relocation (temporary loss) of habitat in stream sections to be relocated, including sections of Howell Creek, 228th Street Creek, and Unnamed Creek
- Possible tree removal in Wetland C in order to accommodate stream relocations

While unavoidable, these impacts are not considered significant because of the ability to mitigate them and to provide a long-term net benefit to ecological functions associated with these streams, wetlands, and vegetation.

Upland forest habitat immediately east of the Route 9 site boundary would be lost due to drainage pipe installation and retaining wall construction at the eastern edge of the site. Impacts to upland forest, including tree removal, are also anticipated on the north portion of the site as a result of stream relocations. Some additional loss of habitat may result from construction of gas and power transmission lines to the site. Similarly, these impacts are not considered significant unavoidable impacts due to the ability to provide substantial reforestation on the site.

Mitigation would be designed to meet local, state, and federal mitigation requirements. Two stream and wetland mitigation areas would be created at the northern and southern ends of the Route 9 site to compensate for unavoidable impacts. These mitigation areas are discussed above under the proposed mitigation section specific to the Route 9 site.

During construction of the 36/54-mgd and 72-mgd plants on the Unocal site, 12 to 14 acres of the upland forest slope adjacent to Puget Sound would be lost, respectively. This forest slope provides potential shelter, forage, and nest sites for some animals associated with the Puget Sound shoreline, including special status species such as bald eagle and

great blue heron. These forested areas also provide links to other forested habitats on adjacent properties. Because of the high quality of the habitat, this is considered a significant, unavoidable adverse impact that cannot be fully mitigated onsite. Restoring forested buffer habitat along Willow Creek and Wetland B is expected to provide partial compensation for losses of forest habitat.

Some construction impacts to wetlands would also be unavoidable at the Unocal site. Impacts to wetlands and streams include the following:

- The permanent loss of Wetland C, a small 0.02-acre side-slope seep, for construction of the 36-mgd, 54-mgd, or 72-mgd treatment plant.

- The permanent loss of 0.45 acre of forested/shrub-scrub wetland in Edmonds Marsh (Wetland A), for construction of the 72-mgd plant. A small portion of Willow Creek may also need to be relocated. However, the Willow Creek relocation could be avoided and the wetland loss could be avoided or minimized by optimizing the 72-mgd site layout and/or by using new treatment technologies that may be available in the future.

- A total loss of 0.93 acre of shrub and forested wetland and stream buffer during construction of the 54-mgd plant, with a loss of 2.1 acre for the 72-mgd plant. Buffer impacts for the 72-mgd plant could be minimized by optimizing the site layout and/or by using future treatment technologies.

Some additional loss of habitat may result from construction of gas and power transmission lines to the site.

Mitigation for the Unocal site would be designed to meet local, state and federal mitigation requirements. Mitigation for wetland and stream impacts could be achieved through restoration of all or part of Wetland B (2.3 acres), which is a highly degraded wetland that has been used for stormwater detention. Mitigation could also be achieved through daylighting Willow Creek and through restoring forested wetland and stream buffers. No significant unavoidable impacts to wetlands and streams on the Unocal site are anticipated.

Conveyance

While many of the impacts have been, and will be, avoided through candidate portal site screening and careful placement of construction footprints on the sites, some direct impacts to streams, wetlands, and wildlife habitat would be unavoidable on candidate portal sites. Some acreage of upland habitat would likely be removed for the construction of portals, open cut construction of pipelines connecting to existing sewer lines, construction of power transmission lines, jack-and-bore pits, and microtunneling pits.

Enhancing or restoring lost resources in compliance with local, state, and federal regulations, however, would compensate for these impacts. No significant unavoidable impacts are anticipated. Portal areas would be restored to the original or better condition

after construction is complete. During the design process and the selection of final candidate portal locations, King County will make every effort to avoid impacts to sensitive resources.

Under rare circumstances when all five flow management strategies have been implemented, influent would be discharged from the safety relief point into the Sammamish River upstream of Lake Washington for both the Unocal and Route 9 conveyance alternatives. Overflows would occur approximately once every 100 years upon completion of Phase 1 of the project, and approximately once every 75 years upon buildout of Phase 2. The discharge plume would likely extend the width and depth of the Sammamish River and downstream approximately 3,800 feet into Lake Washington. Surface Water Quality Standards for some constituents would not be met at the edge of the plume for hours or possibly days after such an event. Emergency flows resulting from power failure at the Unocal treatment plant site could also discharge to Puget Sound. King County would post the area, clean up the area as appropriate, and monitor water quality in the vicinity of the overflow to determine when pollutant concentrations have returned to levels consistent with state Water Quality Standards. These impacts would be unavoidable, but because of their rare and temporary nature, they would not be considered significant impacts.

Outfall

Temporary sedimentation and turbidity in the outfall construction zones would be an unavoidable impact, but because of their temporary nature and the ability to mitigate them, would not be considered significant impacts. Installing outfall pipes in trenches through the nearshore would disturb the shoreline and disrupt sediments and vegetation on the seafloor in the zone of construction. Some fish species would be temporarily disturbed or displaced. Outfall construction would impact non-motile invertebrates (such as clams) along the pipeline route, but it is expected that recolonization of the area would occur and that the impact would not be significant over the long term. Mitigation for these short-term construction impacts was outlined earlier in this chapter. The loss and alteration of Puget Sound habitat would be mitigated by the restoration of degraded habitat elsewhere in Puget Sound or other surface waters.

The high effluent quality of the Brightwater System would ensure that most effluent constituents would meet water quality standards within the regulatory mixing zone. There would, however, be unavoidable changes in small amounts of habitat within Puget Sound. These impacts are the creation of a mixing zone surrounding the diffuser and the addition of hard substrate in the form of a pipeline. The installation of the pipeline would alter the existing soft bottom habitat for aquatic biota and provide hard substrate for colonization by encrusting organisms. The mixing zone may have areas where water quality would be degraded. Given the location of the diffuser and levels of dilution, it is highly unlikely that there would be any human contact sufficient to cause harm.

7.5 Summary of Impacts and Mitigation

Table 7-28 provides a summary of impacts and mitigation measures related to plants, animals, and wetlands for the Brightwater System alternatives.

Table 7-28. Summary of Potential Plants, Animals, and Wetlands Impacts and Proposed Mitigation for Brightwater Systems

Brightwater System	System Component	Impacts	Proposed Mitigation
Common to All Systems	Treatment Plant	Construction • Habitat loss, including loss of cover, nest sites, foraging areas, and corridors for wildlife movement. • Mortality of some individual animals, particularly ground dwelling animals, is likely. • Loss of a small amount of wetland and buffer, which may affect wetland functions. • If unmitigated, potential for erosion from grading and earth moving activities and increased sedimentation/turbidity in adjacent surface waters. Potential effects to fish and other aquatic species include loss of eggs or young, behavioral changes/avoidance of the area, and reduction in available forage. • If unmitigated, potential for incidental or accidental discharge of fuels, oil, grease, hydraulic fluid, or combustion exhaust to surface waters. • Potential diversion of water that feeds streams or wetlands during construction and lowering of water levels. Potential mortality or stress to aquatic species. • Discharge of dewatering water to streams could alter flows and stream water quality. Impacts to fish behavior and in-stream habitat could occur. • Construction noise may affect wildlife activity and communication patterns. • Lighting may disrupt movement of wildlife and alter predator-prey relationships.	Construction • Adhere to federal, state, and local permit conditions and regulations for sensitive or critical areas, such as wetlands, streams, and fish and wildlife habitat, including mitigation sequencing and mitigation measures. • Clearly identify construction boundaries to avoid encroachment into adjacent habitat areas. • Minimize clearing of vegetation to the extent possible and protect vegetation remaining onsite from damage during construction to reduce the loss of wildlife habitat and movement corridors. • Comply with clearing and grading BMPs and employ a Stormwater Pollution Prevention Plan that will prevent or minimize sedimentation of on- and offsite water bodies. • Minimize night lighting during construction and operations, especially in stream and wetland habitats. • Utilize vibratory pile driving instead of impact pile driving where feasible. • Implement a site specific dewatering plan to minimize impacts during dewatering activities. • Prepare and follow a Spill Prevention, Containment, and Control Plan for site construction. • Schedule construction within work windows specified by WDFW, COE, NOAA Fisheries, and/or USFWS to avoid critical periods for wildlife and fish. Confine in-stream work, where unavoidable, to the period designated by WDFW when salmonids are least likely to be present in the system.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Common to All Systems (cont.)	Treatment Plant (cont.)		Construction • Perform boring at adequate depths below surface waters to avoid or minimize the opportunity of slurry materials reaching surface waters. • Comply with any requirements imposed by NOAA Fisheries and/or USFWS regarding federal special status species. • If nests of state-protected special status species are reported on or near the site, follow WDFW requirements to protect the nest site during the breeding season. Impacts to habitats that support special status species will be avoided and minimized to the extent possible at either site. • Minimize work in aquatic habitats to the extent possible. Potential mitigation measures for protecting wetlands and fish habitat include avoiding work in aquatic habitats and avoiding sediment transport to aquatic habitats and their buffers. Potential mitigation measures for in-water work would include the removal and salvage of fish from the project area (ponds) to undisturbed upstream or downstream habitat if they are present during construction. • Work with WDFW and Ecology to meet all applicable permitting requirements, including the Hydraulic Project Approval and Section 401 of the federal Clean Water Act.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Common to All Systems (cont.)	Treatment Plant (cont.)	Operation • Runoff from new impervious surfaces; slight potential for impacts to surface waters from spills of chemicals. • Increased operational noise levels over existing conditions, particularly during nighttime operation, may reduce noise sensitive wildlife species.	Operation • Use low impact development (LID) practices to minimize the impacts of impervious surfaces including minimizing the building, parking, and roadway footprints, using permeable materials for roads and parking areas, collecting roof runoff and providing areas for re-infiltration, amending soil in landscaped areas, landscaping with native plants, and incorporating vegetated roofs into treatment plant design. • System would be designed to prevent overflows to upland, wetland, and stream habitats in the plant vicinity. • Spill prevention measures such as leak detection systems, secondary containment, drainage retention, and regular inspection and maintenance will be developed consistent with the UFC and other applicable regulations. Storage tanks will be designed with double walls, spill containment berms, alarms, level indicators, ventilation, and other features to minimize spill risks and impacts. • Direct night lighting only to developed treatment site areas, and restrict operational noise in accordance with Snohomish County or City of Edmonds noise control regulations.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Common to All Systems (cont.)	Conveyance	Construction • Most candidate portal sites would avoid impacts to sensitive areas. • Potential for impacts to sensitive areas from construction of local connections. Potential erosion and sedimentation from excavation and backfilling of microtunnel pits. Potential indirect impacts to sensitive areas from spills, dewatering, and increased noise and lighting. • Potential impacts to wildlife from loss of vegetation on undeveloped or partially developed candidate portal sites. Some individuals of wildlife may perish if dispersal to other habitats not possible. • Potential increase in habitat fragmentation and loss of wildlife linkages due to loss of vegetated habitat on portal sites. Potential for increased stress to wildlife and increase in edge effects. • Minor amounts of vegetation clearing for construction of electrical lines to serve portal facilities. • Potential impacts to stream habitat and fish from temporary removal of vegetation in riparian areas. • Potential lowering of groundwater supporting streams and wetlands. Potential mortality or stress to species inhabiting these areas. Small streams most susceptible, particularly during summer low flow conditions. Active spawning redds or fry could be impacted. • Potential alteration of water levels in wetlands or streams from discharge of dewatering water. Discharge may alter habitat or fish behavior. Discharge may also alter water quality. • Potential impacts to wetlands or vegetated buffers from construction of safety relief point along the Sammamish River.	Construction • Employ best management practices for erosion and sedimentation, accidental and incidental discharge of pollutants, dewatering and discharge of dewatering water, and increased noise and lighting levels. • Comply with applicable federal, state, and local regulations for impacts to sensitive areas including wetlands, streams, buffers, and significant trees. If wetlands or buffers are permanently impacted, use appropriate compensatory mitigation ratios to calculate the area of wetland or buffer creation, restoration, and/or enhancement necessary to mitigate for impacts. • Avoid and minimize impacts to special status species present near construction sites through timing restrictions (e.g., fish and bald eagle work windows). • Use water quality treatment where appropriate before releasing construction water to wetlands or streams, and release dewatering water at a rate consistent with Ecology guidelines. • Microtunnel to avoid impacts to wetlands and streams during the construction of local connections.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
	Conveyance (cont.)	Operation • Similar in type but lesser in scale compared to treatment plant impacts. • Potential stormwater runoff impacts from completed portals. Some runoff may not be treated because site falls below impervious surface thresholds. • Terrestrial species in vicinity of safety relief point that do not avoid area may become temporarily ill during emergency overflows, should one occur. • Potential avoidance of area by fishes if an emergency overflow occurs. Mortality of fishes, including juvenile salmonids, is possible during overflows. Potential for long-term bioaccumulation of metals in aquatic species from contamination of sediments.	Operation • Portal sites that are not retained for continued use after construction could be revegetated and monitored to ensure successful habitat reestablishment. • If necessary, portal sites will have stormwater facilities to avoid or minimize impacts associated with runoff to nearby wetlands or surface waters. • Implement flow management strategies to minimize the likelihood of overflows; in case of catastrophic events that result in overflows, flows would be directed to larger water bodies (i.e., Sammamish River and Lake Washington) via the safety relief point to increase dilution and reduce habitat impacts.
Common to All Systems (cont.)	Outfall	Construction • Disturbance to approximately 6,200 to 6,750 linear feet of marine habitat in Zones 7S and 6, respectively. Impacts would range from shoreline/riparian areas down to deep subtidal habitat. • Temporary impacts to marine mammals, including avoidance of the construction area and potential effects to prey such as forage fish, from noise and construction activity. • Temporary impacts to marine birds, including avoidance and effects to prey such as forage fish. • Temporary impacts to marine fish and their habitat from construction activity, noise, and turbidity. Impacts would include avoidance of area. Displacement greatest in nearshore area. • Potential impacts to sand lance and surf smelt habitat. Potential displacement of spawning activity.	Construction • For upland portions of the outfall construction, clearing of vegetation would be minimized where feasible and vegetation remaining onsite protected from damage during construction. • Appropriate best management practices would be employed to avoid and minimize the potential for construction impacts, including erosion and sedimentation, and accidental and incidental discharge of pollutants. • King County will comply with any requirements imposed by NOAA Fisheries and/or USFWS regarding federal special status species. • Opportunities for onsite mitigation are limited because of the highly degraded/developed condition of the shoreline (existing railroad tracks and tank farm). Therefore, it may be appropriate to consider restoration of habitat outside the outfall corridor.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Common to All Systems (cont.)	Outfall (cont.)	Construction (cont.) • Flatfish may suffer direct mortality underneath 4,000 to 4,300 feet of pipe laid offshore. • Trench construction would destroy shellfish in bottom sediments. Impacts would be greatest in shallower waters where shellfish density is highest. More motile shellfish species would likely avoid trench and recolonize area following construction. • Non-mobile benthic invertebrate species found in and on sediments would be destroyed during trench construction. • Laying of pipe for offshore segment would also lethally impact benthic organisms. • Tug boats may scour bottom sediments, which could temporarily increase turbidity, and impact vegetation and aquatic organisms • Use of spuds to anchor working barges could temporarily or lethally impact invertebrates over an area of 0.35 to 0.46 cubic yards per spud and create small sediment plumes. • Trenching would remove sea lettuce, eelgrass, and other macroalgal species. Spills of materials resulting in turbidity while loading barges, along with barge shading, may temporarily inhibit macroalgae growth. • Temporary impacts to the sport fishery and spot prawn fishery may occur due to noise and barge traffic. • Potential for spills of construction-related chemicals.	Construction (cont.) • The preferred outfall alignment has the shortest possible nearshore segment. Selection of this alignment minimized effects on plants and animals in sensitive nearshore habitat. • Use sheet piles to minimize trench widths on land and in shallow subtidal habitat to a depth of at least –30 feet MLLW. • Limit work to established construction schedule windows to minimize impacts to juvenile salmonids, sand lance, surf smelt, and other fish. To mitigate potential loss of sand lance and surf smelt spawning habitat and some larval or juvenile macroinvertebrates during trench excavation, perform construction during work windows, use sheet piling to minimize trench footprint, and restore habitat. • Restore existing substrates with similar materials placed to match the pre-construction bathymetry or topography. To the extent possible, use excavated material in replacing substrate. • Replant shoreline riparian habitat with existing or native plant species, in consultation with the property owner. Monitor and maintain plantings to ensure success. • Re-plant intertidal and shallow subtidal eelgrass, at a minimum, to reestablish pre-disruption coverage. Transplant eelgrass to the disturbed site to shorten the time for restoration of existing coverage. • Mitigation for the loss of geoducks and other shellfish due to trench excavation will include compensation to the Washington Department of Natural Resources (WA DNR) for their monetary value.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Common to All Systems (cont.)	Outfall (cont.)		Construction (cont.) • Mitigate for the shellfish closure zone and lost harvest opportunities by monetary payment to the state of Washington in accordance with WA DNRs Natural Resource Damage Assessment (NRDA). • Consult with tribal and state biologists to design the pipeline to minimize or eliminate the possibility of fishing gear entanglement. • Implement appropriate spill prevention measures • Mitigate noise during nearshore construction and installation of sheet piling by using a vibrating hammer to reduce noise and time required to install the piling. • Limit construction in the intertidal and shallow subtidal zones to seasonal constraints outlined by WDFW in the Hydraulic Project Approval (HPA) to limit adverse impacts to marine mammals and salmon migration along the shoreline. • During in-water construction, coordinate with affected Treaty Tribes including the Suquamish Tribe and Tulalip Tribes to reduce the potential for disruption of treaty fishing operations.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Common to All Systems (cont.)	Outfall (cont.)	Operation • No measurable impacts to physical water quality parameters beyond regulatory mixing zone of approximately 800 feet in radius. • Discharges of chemicals and metals would meet all existing water quality standards at edge of mixing zone. • Potential small, localized shift to organic-tolerant benthic infaunal communities in immediate vicinity of diffuser. • Potential, but unlikely, impact to benthic organisms during failure or accident resulting in discharge of untreated effluent. Motile species would likely avoid the area. • Potential for small amounts of endocrine disruptors to reach receiving waters. • Potential new geoduck or bivalve closure zone around outfall discharge point. • If unmitigated, potential for entanglement of fishing gear on outfall pipe. • Potential temporary impacts to recreational fish and shellfish harvesting due to emergency releases of untreated effluent. • Along the exposed pipeline, the alteration of habitat will increase the complexity of local biota and the surface area along the exposed portion of the outfall alignment. Outfall would provide more hard substrate for sea anemone, sea stars, and other similar organisms. • Outfall may act as a barrier for free movement of crabs.	Operation • Establish a routine monitoring program around the diffuser once the outfall is operational. • Mitigate for water quality mixing zones by terminating the outfall in a multi-port diffuser structure to promote rapid mixing of effluent and minimizing the amount, if any, of the water column habitat degraded from exceedances above Water Quality Standards. • Deep water location of discharge point near “Triple Junction” would maximize dilution of wastewater. • Selection of the MBR treatment process (with ballasted sedimentation for peak flows) reduces the annual loading of suspended solids to Puget Sound by about 75 percent relative to conventional activated sludge treatment.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Route 9–195th Street System	Treatment Plant	Construction • 0.1 acre of forested wetland (offsite) would be permanently removed due to drainage pipe installation adjacent to the east site boundary. • 0.26 acres of forested wetland (Wetland B) will be affected by a loss or change of hydrology due to the relocation of Unnamed Creek. • 1.5 acres of upland forest (offsite) would be removed due to drainage pipe installation adjacent to the east site boundary. • 0.14 acre of open water and 0.25 acre of riparian shrub (Wetland E – fish rearing pond) would be relocated to the north - a temporary loss of this habitat would result. • Tree and shrub removal and other habitat changes are expected for approximately 0.44 acre of forested and scrub-shrub wetland, 0.41 acre of emergent wetland, 0.87 acre of upland forest, and 2.32 acre of upland grassland due to stream relocations. • Construction noise may reduce numbers of noise-sensitive animals that currently use habitats near the site. • Minor offsite habitat impacts from construction of electrical and gas lines to serve the plant.	Construction • Minimize removal of large trees in upland areas. • Retain onsite large woody debris for stream relocation and enhancement. • Daylight and reroute streams and watercourses. Enhance buffer areas with native plantings. • Perform wetland and stream mitigation as required by local, state, and federal regulations. Replace lost functions at a ratio of greater than 1:1. • Restore degraded upland and wetland habitats on the north and south portions of the site. The specific amount of mitigation proposed will be determined during permitting. • Restrict in-water work to the WDFW in-water work window for fish. • Follow WDFW and USFWS requirements for protecting nesting species if required for special status species.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Route 9–195th Street System (cont.)	Treatment Plant (cont.)	Operation • High existing water temperatures due to stormwater facilities may continue onsite and in adjacent Little Bear Creek. • The decentralized, LID stormwater management system should improve the water quality and reduce peak flows of stormwater from the site, though sediments and other pollutants still may enter Little Bear Creek via the stormwater system. • Operational noise may reduce numbers of noise-sensitive animals that currently use habitats near the site.	Operation • Use LID for stormwater control and measures to minimize stormwater warming. • Use predominantly native plant materials for treatment plant landscaping south of Urban Growth Boundary. • Monitor and maintain wetland and stream mitigation areas.
	Conveyance	Construction • Erosion and sedimentation, temporary habitat loss or fragmentation (e.g., vegetation clearing and grading), accidental and incidental discharge of pollutants, dewatering and discharge of dewatering water, and increased noise and lighting levels could occur. • Depending on which primary candidate portal sites are selected for final design, impacts to wetlands, wetland/stream buffers, and/or mature forest would range between 0 acres and 2.13 acres. • Stream channel segments may need to be displaced during construction on two tributaries to Little Swamp Creek (Portal 44, Site C), Little Swamp Creek (Portal 44, Site D), and a tributary to the Puget Sound (Portal 19, Site A). • Depending on if secondary candidate portal sites are selected for final design, impacts to wetlands, wetland/stream buffers, and/or mature forest would range between 0 acres and 0.43 acres. • Potential for impacts at Portal 44 resulting from trenching used to connect to Swamp Creek trunk (similar to construction of local connections described under impacts common to all systems).	Construction • Same as Common to All Systems, above.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
	Conveyance (cont.)	Operation • The operation of portal sites is not anticipated to impact sensitive areas or wildlife after portals have been constructed. • The potential risk of sodium bisulfite spill during transport or at the dechlorination facility located at Portal 5 to migrate offsite is low. A significant discharge of sodium bisulfite to a stream, while highly unlikely, could be lethal to fish by reducing dissolved oxygen levels. • Potential for spills of chemicals used for odor control to migrate offsite at portals also considered low due to chemical handling procedures and containment features.	Operation • Once chemicals are safely within storage tanks, risk of a spill would be minimal because of safety controls such as double walls, spill containment berms, and other facilities that would convey any spills to a drain that enters the sanitary sewer system rather than surface waters.
Route 9–195th Street System (cont.)	Outfall Zone 7S	Construction • Disturbance to approximately 6,200 linear feet of marine habitat in Zone 7S. Impacts would range from shoreline/riparian areas down to deep subtidal habitat. • Impacts to 11,000 square feet of shoreline riparian habitat, 27,000 to 45,000 square feet of intertidal/shallow subtidal habitat, and 5,000 linear feet of deep subtidal habitat. • The impact footprint for offshore sections of the outfall would be approximately 22,500 square feet for Zone 7S. • Disturbance of approximately 7,000 shoots of eelgrass. Potential removal of sea lettuce. • Potential direct mortality of benthic macroinvertebrates trapped within 671 cubic yards material excavated from top six inches of trench if sheeted; approximately 1,300 cubic yards if unsheeted.	Construction • Same as Mitigation Common to All Systems, above.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Route 9–195th Street System (cont.)	Outfall Zone 7S	Construction (cont.) • Direct mortality to non-motile benthic macroinvertebrates directly beneath 4,000 feet of installed pipeline. • Between 2,916 and 4,405 cubic yards of excavated sediments may contain shellfish. • Other impacts same as Impacts Common to All Systems, above.	
		Operation • Same as Impacts Common to All Systems, above.	Operation • Same as Mitigation Common to All Systems, above.
Route 9–228th Street System	Treatment Plant	Construction • Same as 195th Street Alternative, above.	Construction • Same as 195th Street Alternative, above.
		Operation • Same as 195th Street Alternative, above.	Operation • Same as 195th Street Alternative, above.
	Conveyance	Construction • Erosion and sedimentation, temporary habitat loss or fragmentation (e.g., vegetation clearing and grading), accidental and incidental discharge of pollutants, dewatering and discharge of dewatering water, and increased noise and lighting levels could occur. • Dependent on which primary candidate portal sites are selected for final design, impacts to wetlands, wetland/stream buffers, and/or mature forest would range between 0 acres and 1.28 acres. • Stream channel segments may need to be displaced during construction on two tributaries to Little Swamp Creek (Portal 44, Site C), Little Swamp Creek (Portal 44, Site D), and a tributary to the Puget Sound (Portal 19, Site A).	Construction • Same as 195th Street Alternative, above.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Route 9–228th Street System (cont.)	Conveyance (cont.)	Construction (cont.) • Depending on if secondary candidate portal sites are selected for final design, impacts to wetlands, wetland/stream buffers, and/or mature forest would range between 0 acres and 0.43 acres. • Impacts from trenching connection at Portal 44 and constructing electrical/gas lines offsite, as discussed for 195th Street conveyance above.	
		Operation • The operation of portal sites is not anticipated to impact sensitive areas or wildlife after portals have been constructed. • The risk for a sodium bisulfite spill during transport, or a spill to migrate offsite at the dechlorination facility located at Portal 26 is low. Spills of chemicals used at portals unlikely to migrate offsite due to handling procedures and spill containment features. A significant discharge of chemicals to a stream, while highly unlikely, could be lethal to fish by reducing dissolved oxygen levels.	Operation • Same as 195th Street Alternative, above.
	Outfall Zone 7S	Construction • Same as 195th Street Alternative, above.	Construction • Same as 195th Street Alternative, above.
		Operation • Same as 195th Street Alternative, above.	Operation • Same as 195th Street Alternative, above.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Unocal System	Treatment Plant	Construction • Approximately 12 acres of upland forest would be permanently removed for the 36-mgd and 54-mgd plants, and 14 acres would be removed for the 72-mgd plant. • Loss of potential nest or roost sites for special status species including great blue heron, bald eagle, pileated woodpecker, osprey, Vaux's swift, merlin, and Keen's, long-eared, and long-legged myotis. • Approximately 0.37 acre of upland shrub including wetland/stream buffer areas would be permanently removed. • 0.02 acre of forested wetland (Wetland C) would be removed for the 36-mgd and 54-mgd plants, and 0.47 acres of forested wetland (Wetland C and portions of Wetland A – Edmonds Marsh) would be removed for the 72-mgd plant. • Dewatering may result in minor temporary changes in hydrology (water levels) or salinity in Edmonds Marsh and Willow Creek. • Changes in hydrology or salinity may affect coho salmon. • Construction noise, including pile driving, may reduce numbers of noise-sensitive animals that currently use habitats near the site. • Minor offsite habitat impacts from construction of electrical and gas lines to serve the plant.	Construction • Willow Creek would be daylighted and relocated southeast of the BNSF railroad and conveyed below the railroad to an open channel to Puget Sound. • In-water work would be restricted to the WDFW in-water work window for fish. • WDFW and USFWS requirements for protecting nesting species would be followed, such as placing timing restrictions on pile driving because a known bald eagle nest is located within one mile of the pile driving activities. • Wetland mitigation would be implemented as required by City of Edmonds, state, and federal regulations. • Degraded wetland and upland buffer habitats within and adjacent to Wetland B would be restored. • Temporary construction and permanent stormwater treatment would be provided to protect adjacent resources in Puget Sound. Water levels would be maintained in the adjacent Edmonds marsh and Willow Creek during construction dewatering by using measures such as a combination of cutoff walls and supplemental watering with clean water from dewatering operations. The dewatering water would be treated, if needed, to remove remaining petroleum contaminants prior to release to the marsh. Water levels would be monitored on a regular basis during the construction period.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Unocal System (cont.)	Treatment Plant (cont.)	Operation • The stormwater management system should improve the water quality and reduce peak flows of stormwater from the site, though sediments and other pollutants still may enter Puget Sound via the stormwater system. • Operational noise may reduce numbers of noise-sensitive animals that currently inhabit Edmonds Marsh, Puget Sound, and other habitats adjacent to the site.	Operation • Native landscaping would be used to revegetate disturbed areas adjacent to proposed development. • Monitor and maintain wetland and stream mitigation areas. • Other mitigation same as Common to All Systems, above.
	Conveyance	Construction • Erosion and sedimentation, temporary habitat loss or fragmentation (e.g., vegetation clearing and grading), accidental and incidental discharge of pollutants, dewatering and discharge of dewatering water, and increased noise and lighting levels could occur. • No impacts to wetlands, wetland/stream buffers, and/or mature forest would occur at any of the primary portal sites. • Without mitigation, construction noise could impact bald eagle activities in the vicinity of Portal 11. • Dependent on if secondary candidate portal sites are selected for final design, impacts to wetlands, wetland/stream buffers, and/or mature forest would range between 0 and 0.5 acres.	Construction • Same Common to All Systems, above.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Unocal System (cont.)	Conveyance (cont.)	Operation • The operation of portal sites is not anticipated to impact sensitive areas or wildlife after portals have been constructed. • The risk of a chemical spill during transport, or a spill migrating offsite at the pump station facility located at Portal 11 or during chemical use for odor control at Portal 7 is considered low due to chemical handling procedures and design features. A significant discharge of chemicals to a stream, while highly unlikely, could be lethal to fish by reducing dissolved oxygen levels.	Operation • Same as Common to All Systems, above.
	Outfall Zone 6	Construction • Disturbance to approximately 6,750 linear feet of marine habitat in Zone 6. Impacts would range from shoreline/riparian areas down to deep subtidal habitat. • Impacts to 10,000 square feet of shoreline riparian habitat, 51,000 to 85,000 square feet of intertidal/shallow subtidal habitat, and 5,000 linear feet of deep subtidal habitat. • The impact footprint for offshore sections of the outfall would be approximately 24,000 square feet for Zone 6. • Disturbance of approximately 23,000 shoots of eelgrass. • Potential direct mortality of benthic macroinvertebrates trapped within 648 cubic yards material excavated from top 6 inches of trench if sheeted; 1,760 cubic yards if unsheeted. • Direct mortality to non-motile benthic macroinvertebrates directly beneath 4,300 feet of installed pipeline. • Between 3,038 and 4,253 cubic yards of excavated sediments may contain shellfish. • Other impacts same as Impact Common to All Systems, above.	Construction • Same as Common to All Systems, above.

Table 7-28. Summary of Potential Impacts to Plants, Animals, and Wetlands and Proposed Mitigation for Brightwater Systems (cont.)

Brightwater System	System Component	Impacts	Proposed Mitigation
Unocal System (cont.)	Outfall Zone 6 (cont.)	Operation • Same as Impact Common to All Systems, above.	Operation • Same as Common to All Systems, above.
No Action		Construction • No construction related impacts from Brightwater project. • Potential impacts to habitats and species on treatment plant sites from future urban development.	Construction • No mitigation measures identified.
		Operation • Potential for increased discharges of overflows to area streams, rivers, and lakes including the Sammamish River, Lake Washington, and the Green River. Potential for eutrophication if overflows become more frequent in future. Potential impacts to aquatic species, including salmonids.	Operation • No mitigation measures identified.

7.6 References

Armstrong, J.C., Staude, C., Thom, R., and Chew, K. 1976. Habitats and relative abundance of the intertidal macrofauna at five Puget Sound beaches in the Seattle area. *Syesis 9*:277–290

Audubon Society. 2002. Christmas Bird Count 102nd Count Summary for Edmonds, Washington. National Audubon Society. http://www.audubon.org/bird/cbc/hr/index.html

Bargmann, G. 2003. Greg Bargmann, Washington Department of Fish & Wildlife, Olympia, WA. Personal communication to Kimberle Stark, July 16, 2003.

Battelle, Pentec, Striplin, and Shapiro. 2001. *Reconnaissance assessment of the states of the nearshore ecosystem: Eastern shore of Central Puget Sound, including Vashon and Maury Islands (WRIAs 8 and 9).* Prepared by Battelle Marine Sciences Laboratory, Pentec Environmental, Inc., Edmonds, WA, Striplin Environmental Associates, and Shapiro Associates for King County Department of Natural Resources. Seattle, WA.

Boatman, C., C. Ebbesmeyer, J. Scott, T. Wang, M. Francisco, B. Schmoyer, T. Floyd, T. Michelsen, and D. Norton. 1995. Elliott Bay Waterfront Recontamination Study, Volume II: Data Evaluation and Remedial Design Recommendations Report. Prepared for the Elliott Bay/Duwamish Restoration Program Panel by the Aura Nova Consultants contractor team and Washington State Department of Ecology. Panel Publication No. 10.

Brookshire, J., 2002. J. Brookshire, Washington Department of Fish and Wildlife, Olympia, WA. Personal communications in telephone conversations, June 13, July 2, and July 30, 2002.

Caine, E. 2002. Ed Caine, Snohomish County Planner, Everett, WA. Personal communication at site visit to SR-9 site. March 7, 2002.

Chang, B.D., and Levings, C.D. 1976. Laboratory experiments on the effects of ocean dumping on benthic invertebrates II: Effects of burial on the heart cockle (*Clinocarium nuttalli*) and on the Dungeness crab (*Cancer magister*). Environment Canada, *Fisheries and Marine Service Tech. Rep.* 662.

COE (U.S. Army Corps of Engineers). 1944. *Aerial photograph*. Northwest Section, N. 18-26. 1:20,000.

COE (U.S. Army Corps of Engineers). 1987. Wetlands delineation manual. COE Waterways Experiment Station, Vicksburg, MS. *Environmental Laboratory Tech. Rep. Y-87-1*. NTIS No. AD A176 912. 79 pp. plus appendix.

COE (U.S. Army Corps of Engineers). 1993. A hydrogeomorphic classification for wetlands. By M.M. Brinson. *Wetland Research Program Tech. Rep.* WRP-DE-4.

Cooke, S.S. 1996. *Wetland and buffer functions semi-quantitative assessment form. Preliminary draft user's manual*. Seattle, WA: Cooke Scientific Services. August 1995.

Cowardin, L.M., Carter, V., Golet, F.C., and LaRoe, E.T. 1985 revision of original 1979 ed. Classification of wetlands and deepwater habitats of the United States. *U.S. Fish and Wildlife Service Pub.* FWS/OBS-79/31.

David Evans and Associates, Inc. 2002. *Little Bear Creek Corridor habitat assessment*. Prepared for City of Woodinville, WA. July 2002.

Debose, A., and Klungland, M.W. 1983. *Soil survey of Snohomish County area, Washington*. U.S. Department of Agriculture, Soil Conservation Service.

Dethier, M.N. 1990. *A marine and estuarine habitat classification system for Washington State.* Olympia, WA: Washington State Department of Natural Resources, Natural Heritage Program. 56 pp.

Dethier, M.N., and Schoch. 2000. *The shoreline biota of Puget Sound: Extending spatial and temporal comparisons.* Prepared for Washington State Department of Natural Resources, Nearshore Habitat Program. Olympia, WA.

Doty, D.C., Buckley, R.M., and West, J.E. 1995. Identification and protection of nursery habitats for juvenile rockfish in Puget Sound, Washington. *Proceedings*, *Puget Sound Research 1995*. Olympia, WA: Puget Sound Water Quality Authority.

Ecology (Washington State Department of Ecology). 1993. Washington State wetlands rating system—Western Washington (2nd ed.). *Washington State Department of Ecology Publication* 93-74.

Ecology (Washington State Department of Ecology). 1997. Washington State wetlands identification and delineation manual. *Washington State Department of Ecology Publication* 96-94.

Evergreen Publishing. 1989. *Fishing guide of Washington waters.* Seattle, WA.

Feist, B.E., Anderson, J.J., and Miyamoto, R. 1992. *Potential impacts of pile driving on juvenile pink (Oncorhynchus gorbuscha) and Chum (O. keta) salmon behavior and distribution*. Seattle: University of Washington School of Fisheries, Fisheries Research Institute.

Fevold, K., May, C.W., Berge, H., and Ostergaard, E. 2001. *Habitat inventory and assessment of three Sammamish /river tributaries: North, Swamp, and Little Bear Creeks*. Seattle, WA: King County Water and Land Resources Division.

FHWA (U.S. Department of Transportation, Federal Highway Administration), WSDOT (Washington State Department of Transportation), and Edmonds (City of Edmonds, WA). 1985. *Edmonds Crossing project discipline report: Water quality*. Prepared by Herrera Environmental Consultants.

FHWA (U.S. Department of Transportation, Federal Highway Administration), WSDOT (State Department of Transportation), and Edmonds (City of Edmonds, WA). 1995. *Edmonds Crossing project discipline report: Vegetation, fisheries, and wildlife*. Prepared by CH2M HILL, Bellevue, WA, and Adolfson Associates.

FHWA (U.S. Department of Transportation, Federal Highway Administration), WSDOT (Washington State Department of Transportation), and Edmonds (City of Edmonds, WA). 1998. *SR 104 Edmonds Crossing: Connecting ferries, buses, and rail. Draft Environmental Impact Statement and draft section 4(f) evaluation.* Prepared by CH2M HILL, Bellevue, WA. February 1998.

Foley, S. 2001. S. Foley, Fisheries Biologist, Washington Department of Fish and Wildlife, Mill Creek, WA. Personal communication in telephone conversation, December 21, 2001.

Golder and Parametrix. 2002. *A geoduck (Panopea abrupta) survey for the Brightwater Marine Outfall.* Prepared by Golder Associates, Parametrix, Inc., Kirkland, WA, and King County for King County Department of Natural Resources and Parks, Wastewater Treatment Division. October 2002.

Harbo, R.M. 1999. *Whelks to whales: Coastal marine life of the Pacific Northwest. A field guide*. Victoria, Canada: Heritage House.

Haw and Buckley. 1973. *Saltwater fishing in Washington*. Seattle, WA: Stan Jones.

Higgins, K. 2003. Kollin Higgins, King County Department of Natural Resources and Parks, Seattle, WA. Personal communication to Kimberle Stark, August 5, 2003.

Johnson, D.H., and O'Neil, T.A. 2001. *Wildlife habitat relationships in Oregon and Washington*. Corvallis: Oregon State University Press.

Kerwin, J. 2001. *Salmon and steelhead habitat limiting factors report for Cedar-Sammamish Basin (Water Resources Inventory Area 8)*. Olympia, WA: Washington Conservation Commission.

King County. 2000. *Literature review and recommended sampling protocol for bull trout in King County*. *Final draft.* Prepared by R2 Resource Consultants for King County Department of Natural Resources. Seattle, WA. June 12, 2000.

King County. 2001. *Biological resources report. Brightwater Siting Project Marine Outfall Siting Study, Phase 2.* Prepared by Striplin Environmental Associates, Parametrix, Inc., Kirkland, WA, and King County for King County Department of Natural Resources and Parks. Seattle, WA. September 2001.

King County. 2002a. *Biological resources report. Brightwater Marine Outfall Phase 3*. Seattle, WA. October 2002.

King County. 2002b. *Digital aerial photographs. Seattle, WA*. Color 2-foot pixel resolution, Walker and Associates, Seattle, WA.

King County 2002c. *Known freshwater distribution of salmon and trout for water resource inventory area (WRIA) 8 – Greater Lake Washington Watershed*. Retrieved from Web site of King County Department of Natural Resources and Parks, Water and Land Resources Division: http://dnr.metrokc.gov/WRISA/8/fish-maps/distmap.htm

King County 2002d. *The Lake Washington story*. Retrieved May 24, 2002 from http://dnr.metrokc.gov/wlr/waterres/lakes/biolake.htm

King County. 2002e. *Lake Washington water quality overview and detailed graphs*. Retrieved May 6, 2002 from http://dnr.metrokc.gov/wlr/waterres/lakes/Monitor.htm

King County. 2002f. *Near-term action agenda for salmon habitat conservation. Lake Washington/ Cedar/ Sammamish Watershed (WRIA 8). Draft.* Seattle, WA. February 2002.

King County. 2002g. *Sediment chemistry and benthic infauna, final report. Baseline sediment characterization study for the Brightwater Marine Outfall.* Seattle, WA: King County Department of Natural Resources and Parks. June 2002.

King County. 2002h. Underwater video survey (to be provided). King County. 2002. Brightwater Marine Outfall, Phase 3 Biological Resources Report. King County Department of Natural Resources and Parks, Seattle, WA.

King County. 2002i. *Results of a Human Use Survey of Puget Sound Shorelines*. King County Department of Natural Resources. 2002.

Knutson, M. 2002. Marilyn Knutson, Audubon Society, WA. Personal communication in conversation with Kris Lepine, Herrera Environmental Consultants, in Portal Siting Area 12 regarding wildlife presence within Aquatic Resource 129, July 31, 2002.

Larkin, R.P. 1995. Human noise and wildlife. *Illinois Natural History Survey Report* 2115. January/February 1995. Retrieved from http://www.inhs.uiuc.edu/chf/pub/surveyreports/sr-index.html

Lassuy, D.R. 1989. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest)—Pacific herring. *U.S. Fish and Wildlife Service Biological Report* 82(11.126). U.S. Army Corps of Engineers TR-EL-82-4. 18 pp.

Long, E.R., Hameedi, J., Robertson, A., Dutch, M., Aasen, S., Welch, K., Magoon, S., Carr, R.S., Johnson, T., Biedenbach, J., Scott, K.J., Mueller, C., and Anderson, J.W. 2000. Sediment quality in Puget Sound, Year 2—Central Puget Sound. *NOAA Technical Memorandum* 147 and *Washington State Department of Ecology Publication* 00-03-055.

Marko, J.R. 2003. *Considerations of evidence for noise generation by underwater gas pipelines and presentation of laboratory data relevant to the acoustic insulation properties of concrete pipeline cladding.* Prepared by ASL Environmental Sciences for Georgia Strait Crossing Pipeline, Ltd. 19 pp.

Metro (Municipality of Metropolitan Seattle, WA). 1988. *Quality of local lakes and streams: 1986–1987 status report*. Municipality of Metropolitan Seattle, Water Resources Section.

Metro (Municipality of Metropolitan Seattle, WA). 1989. *Quality of local lakes and streams: 1987–1988 status report*. Municipality of Metropolitan Seattle, Water Resources Section.

Metro (Municipality of Metropolitan Seattle, WA). 1990. *Quality of local lakes and streams: 1988–1989 status report*. Municipality of Metropolitan Seattle, Water Resources Section.

Metro (Municipality of Metropolitan Seattle, WA). 1994. *Water quality of small lakes and streams, Western King County 1990–1993*. King County Department of Metropolitan Services, Water Pollution Control Department, Water Resources Section.

Middaugh, R. 2002. Randy Middaugh, Snohomish County Senior Biologist, Everett, WA. Personal communication in telephone conversation with L. Krippner. March 25, 2002.

NMFS (National Marine Fisheries Service). 2000. *Biological Opinion, Kennedy Memorial Bridge Replacement Project, WSB-00-092, for the Federal Highway Administration.* U.S. Department of the Interior, National Marine Fisheries Service, Northwest Region, Washington State Habitat Branch, Seattle, WA. October 17, 2000.

Nightingale, B. and C. Simenstad. 2001. Dredging Activities: Marine Issues. Submitted to Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington Department of Transportation by B. Nightingale and C. Simenstad, University of Washington.

NOAA (National Oceanic and Atmospheric Administration) and Ecology (Washington State Department of Ecology). 2000. Sediment quality in Puget Sound. Year 2–Central Puget Sound. NOAA Center for Coastal Monitoring and Assessment, Silver Spring, MD; and Washington State Department of Ecology Monitoring and

Trends Section, Olympia, WA. *NOS NCCOS SSMA Technical Memorandum* 147. *Washington State Department of Ecology Publication* 00-03-055.

Null, W.S., Skinner, G., and Leonard, W. 2000. *Wetland functions characterization tool for linear projects*. Prepared for Washington State Department of Transportation, Environmental Affairs Office. Olympia, WA. June 2000.

Parametrix. 1996. *West Point Secondary Treatment Facilities: Bald Eagle Monitoring, Annual Report for 1995-96 Nesting Season*. Prepared for King County Department of Metropolitan Services.

Parametrix. 2001a. *Analysis of human use of Puget Sound shorelines.* Prepared by Parametrix, Inc., Kirkland, WA, for King County Department of Natural Resources. Seattle, WA. September 2002.

Parametrix. 2001b. *Submerged aquatic vegetation patterns in candidate outfall zones*. Prepared by Parametrix, Inc., Kirkland, WA, for King County Department of Natural Resources. Seattle, WA. September 2001.

Parametrix. 2002a. *Literature review of endocrine disruptors in secondary treated effluent: Toxicological effects in aquatic species*. Prepared by Parametrix, Inc., Kirkland, WA, for King County Department of Natural Resources. Seattle, WA. January 2002.

Parametrix. 2002b. *Results of a human use survey of Puget Sound shorelines*. Prepared by Parametrix, Inc., Kirkland, WA, for King County Department of Natural Resources and Parks, Wastewater Treatment Division. Seattle, WA. November 2002.

Parametrix and Intertox. 2002. *Water quality investigations, Brightwater Marine Outfall Phase 3.* Technical memorandum prepared by Parametrix, Inc., Kirkland, WA, and Intertox for King County. November 2002.

Parametrix and King County. 2002. *Bioaccumulation and King County secondary treated effluent: Data review, method evaluation, and potential for impacts on Puget Sound aquatic life*. Prepared by Parametrix, Inc., Kirkland, WA, and King County. April 2002.

Pentec. 1995. *Marine resources in the vicinity of potential Washington Ferry terminal sites in Edmonds.* Prepared by Pentec Environmental, Inc., Edmonds, WA for CH2M HILL. Project No. 239-001.

Pilchuck Audubon Society. 2002. *February 5 2002 trip report for Edmonds waterfront*. Retrieved from Pilchuck Audubon Society of Snohomish County Web site: http://www.pilchuckaudubon.org/tripjan02.html

Pilchuck Audubon Society. 2003. *February 11 2003 trip report for Edmonds waterfront.* Retrieved from Pilchuck Audubon Society of Snohomish County Web site: http://www.pilchuckaudubon.org/tripjan03.html

Portland (City of Portland, OR). 2001. *Streamside science and an inventory of significant riparian and wetland resources*. *Discussion draft.* Portland Bureau of Planning. October 2000.

Potter, J. 2000. *Initial observation on the acoustic source levels to be expected and some possible environmental impacts of a proposed gas pipeline.* Report prepared by TERA Consultants, Ltd. 19 pp.

PSWQAT (Puget Sound Water Quality Action Team). 2000. *Puget Sound update.* Seventh report of the Puget Sound Ambient Monitoring Program. Olympia, WA. 127 pp. October 2001.

Radle, A.L. n.d. *The effect of noise on wildlife: A literature review*. World Forum for Acoustic Ecology. Retrieved from the University of Oregon Web site: http://interact.uoregon.edu/MediaLit/wfae/readings/radle.html

Raedeke Associates, Inc. 1997. *Wetland and stream inventory, Waterman property, Snohomish County, Washington*. Prepared for New Ventures Group, Seattle, WA. May 13, 1997.

Richardson, W.J., Greene, Jr., C.R., Malme, C.I., and Thomson, D.H. 1995. *Marine mammals and noise.* San Diego: Academic Press. 576 pp.

Seattle (City of Seattle, WA). 1999. *CSO annual report*. Retrieved from Seattle Public Utilities Web site: http://www.cityofseattle.net/util/CSOPlan/csoplan.htm#Study%20Areas

Shaffer, A. 1998. Kelp bed habitats of the inland waters of western Washington. In *Proceedings, Puget Sound Research 1998*. Olympia, WA: Puget Sound Water Quality Authority.

Simenstad, C.A, Tanner, C.D., Thom, R.M., and Conquest, L.L. 1991. *Estuarine habitat assessment protocol*. Seattle, WA: U.S. Environmental Protection Agency.

Snohomish County. 1987. *Snohomish County Wetland and Stream Inventory*.

Stahlschmidt-Allner, P., Allner, B., Rombke, J., and Knacker, T. 1997. Endocrine disruptors in the aquatic environment. *Environmental Science Policy Research, 4* (3), 155–162.

Stalmaster, M.V. 1987. *The bald eagle*. New York: Universe Books. 227 pp.

Striplin and Battelle. 2001. *King County marine habitat report*. Prepared in support of the Habitat Conservation Plan and the Brightwater Marine Outfall Siting Study by

Striplin Environmental Associates and Battelle Marine Sciences Laboratory for King County Department of Natural Resources and Parks, Wastewater Treatment Division. Seattle, WA. January 2001.

Striplin, P.L., Sparks-McConkey, P., Davis, D.A., and Svendsen, F.A. 1990. Puget Sound Ambient Monitoring Program, Marine sediment monitoring task annual report. *Washington State Department of Ecology Publication* 92-47.

Striplin, P.L., Sparks-McConkey, P., Davis, D.A., and Svendsen, F.A. 1991. Puget Sound Ambient Monitoring Program, Marine sediment monitoring task annual report. Olympia, WA: Washington State Department of Ecology.

Striplin, P.L., Sparks-McConkey, P., Davis, D.A., and Svendsen, F.A. 1993. Puget Sound Ambient Monitoring Program, Marine sediment monitoring task annual report: Analysis of MSMT data from 1989–1991. Olympia, WA: Washington State Department of Ecology.

Talasaea Consultants. 2003. *Wetland and stream delineation sketch maps for the VRJ LLC Property, Snohomish County, Washington*. Woodinville, WA.

Taylor Associates, Inc. 2002. *Bull trout surveys freshwater and marine nearshore. King County Bull Trout Program 2001.* Prepared for King County Department of Natural Resources and Parks. Seattle, WA.

Ternes, T.A., Stumpf, M., Mueller, J., Haberer, K., Wilken, R-D., and Servos, M. 1999. Behavior and occurrence of estrogens in municipal sewage treatment plants. I. Investigations in Germany, Canada and Brazil. *Science of the Total Environment 225*, 81–90.

Tetra Tech. 1990. *Puget Sound ambient monitoring program 1989: Marine sediment monitoring*. Prepared by Tetra Tech, Inc., Bellevue, WA, for Washington State Department of Ecology.

Thom, R.M. 1983. Spatial and temporal patterns of *Fucus distichus* spp. *Edentatus* (de la Pyl.) Pow. (Phaeophyceae: Fucales) in central Puget Sound. *Botanica Marina 24*, 471–486.

Thom, R.M., Armstrong, J.W., Staude, C.P., Chew, K.K., and Norris, R.E. 1976. A survey of the attached flora at five beaches in the Seattle, Washington area. *Syesis 9,* 267–275.

Thompson, W. 2002. Walt Thompson, Washington Council of Trout Unlimited. Personal communication in telephone conversation with Alex Ottley, Adolfson Associates, Seattle, WA. May 12 2002.

Tirhi, M. 2002. M. Tirhi, Washington Department of Fish and Wildlife, Olympia, WA. Personal communication in telephone conversation with L. Krippner, Adolfson Associates, Seattle, WA, May 12 2002.

USFS (U.S. Fish and Wildlife Service). 1998. *A framework to assist in making Endangered Species Act determinations of effect for individual or grouped actions at the bull trout subpopulations watershed scale. Draft.* February 1998.

USFS (U.S. Fish and Wildlife Services). 2003. Listed and proposed endangered and threatened species, critical habitat, candidate species, and species of concern that may occur in the vicinity of the proposed Brightwater Wastewater Treatment Facility Project in King and Snohomish Counties, Washington. FWS REF 1-3-03-SP-0800. March 5, 2003.

WA DNR (Washington State Department of Natural Resources). 1977. *Washington marine atlas. Vol. 2, South inland waters.* Olympia, WA

WA DNR (Washington State Department of Natural Resources). 1999. *The Washington State shore zone inventory*. Retrieved from http://www2.wadnr.gov/nearshore/research/index.asp?sP=y&id=9

Walker & Associates. 2003. *Aerial photographs of the Route 9 site in 1947, 1967, 1976, 1985, and 1993.* Approximate scale 1" = 400'. Seattle, WA.

WashingtonLakes.com. 2002. *Snohomish County fishing lakes.* Retrieved May 24 2002 from http://www.washingtonlakes.com/

Washington Department of Fisheries. 1975. *A catalog of Washington streams and salmon utilization. Vol. 1, Puget Sound region*. By Williams, R.W., Laramie, R.M., and Ames, J.J. Olympia, Washington.

Waters, T. F. 1995. Sediment in streams; sources, biological effects and control. *American Fisheries Society Monograph* 7.

Watson, J. 2002. Comparative home ranges and food habits of bald eagles nesting in four aquatic habitats in Western Washington. *Northwestern Naturalist 83*, 101–108.

Watson, J.W., and Pierce, D.J. 1998. *Ecology of bald eagles in Western Washington with an emphasis on the effects of human activity. Final report*. Olympia, WA: Washington Department of Fish and Wildlife, Wildlife Research Division. May 1998.

WDFW (Washington State Department of Fish and Wildlife). 2001a. *2002–2003 Region 2 Pandalid Shrimp Harvest Management Plan.* Olympia, WA.

WDFW (Washington State Department of Fish and Wildlife). 2001b. *Washington State status report for the bald eagle.* By Stinson, D.W., Watson, J.W., and McAllister, K.R. Olympia, WA. October 2001.

WDFW (Washington State Department of Fish and Wildlife). 2002a. *Habitats and species database*. Olympia, WA.

WDFW (Washington State Department of Fish and Wildlife). 2002b. *Priority anadromous and resident fish presence report from the Streamnet database.* Olympia, WA. February 13, 2002.

WDFW (Washington State Department of Fish and Wildlife). 2003a. *Habitats and species database*. Olympia, WA.

WDFW (Washington State Department of Fish and Wildlife). 2003b. *Puget Sound creel report.* Retrieved from http://www.wa.gov/wdfw/fish/creel/puget/

West, J.E. 1997. *Protection and restoration of marine life in the inland waters of Washington State.* Prepared for the Puget Sound/Georgia Basin International Task Force, Washington Work Group on Protecting Marine Life.

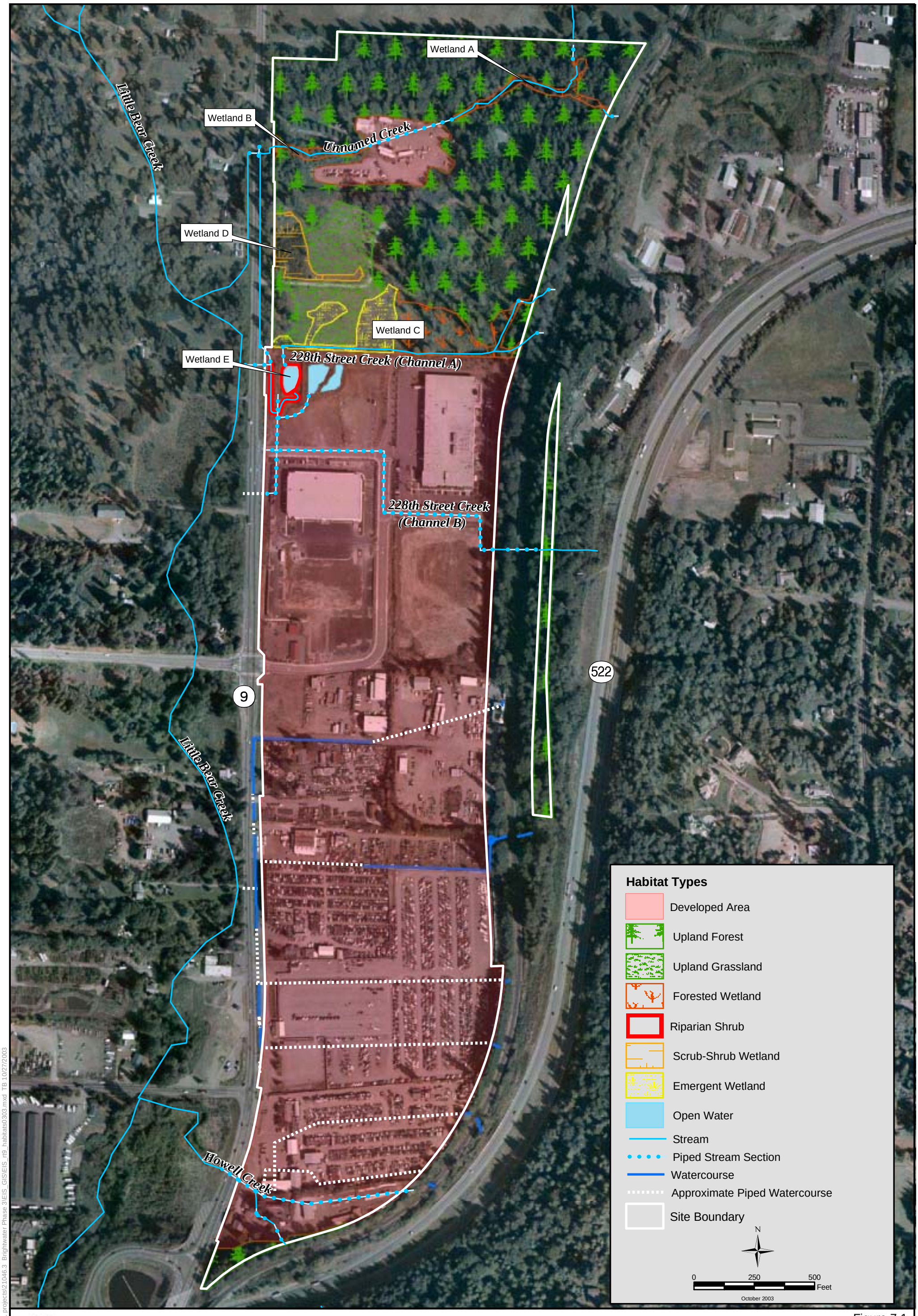
Wintgens, T., M. Gallenkemper, and T. Melin. 2002. Endocrine disruptor removal from wastewater using membrane bioreactor and nanofiltration. *Desalinization 146*, 387–391.

Wood-McGuiness, K. 2002. Karen Wood-McGuiness, Water Quality Steward, Snohomish County Surface Water Management. Personal communication, Snohomish County, WA, May 8, 2002.

Woodruff, D.L., Farley, P., Borde, A., Southard, J., and Thom, R. 2001. *King County nearshore habitat mapping data report: Picnic Point to Shilshole Bay Marina*. Prepared by Battelle Marine Sciences Laboratory, Sequim, WA, for King County Department of Natural Resources. Seattle, WA.

Word, J.Q., Striplin, P.L., and Chew, K.K. 1981. *Richmond Beach sewage outfall survey: A survey of benthic subtidal communities*. Prepared for Municipality of Metropolitan Seattle, WA.

LIST OF FIGURES



King County
Department of
Natural Resources and Parks
Wastewater Treatment
Division

Sources: Aerial photos, King County (2002); Streams, wetlands and watercourses, Snohomish County (2002), Adolfson and Talasaea field surveys (2002, 2003), CH2MHILL CADD survey (2002), Reid Middleton CADD survey (2003)

File Name: EIS_rt9_habitats0303.mxd Prepared by: Adolfson Associates, Inc.

Figure 7-1

Habitat Types on the Route 9 Site

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King County
Department of
Natural Resources and Parks
Wastewater Treatment
Division

Data Sources: King County Aerial 2001; Snohomish GIS 1999
wetland and stream boundaries, CH2MHill 1997

File Name: EIS_Unocal_habtypes.mxd **Prepared by: Adolfson Associates, Inc**

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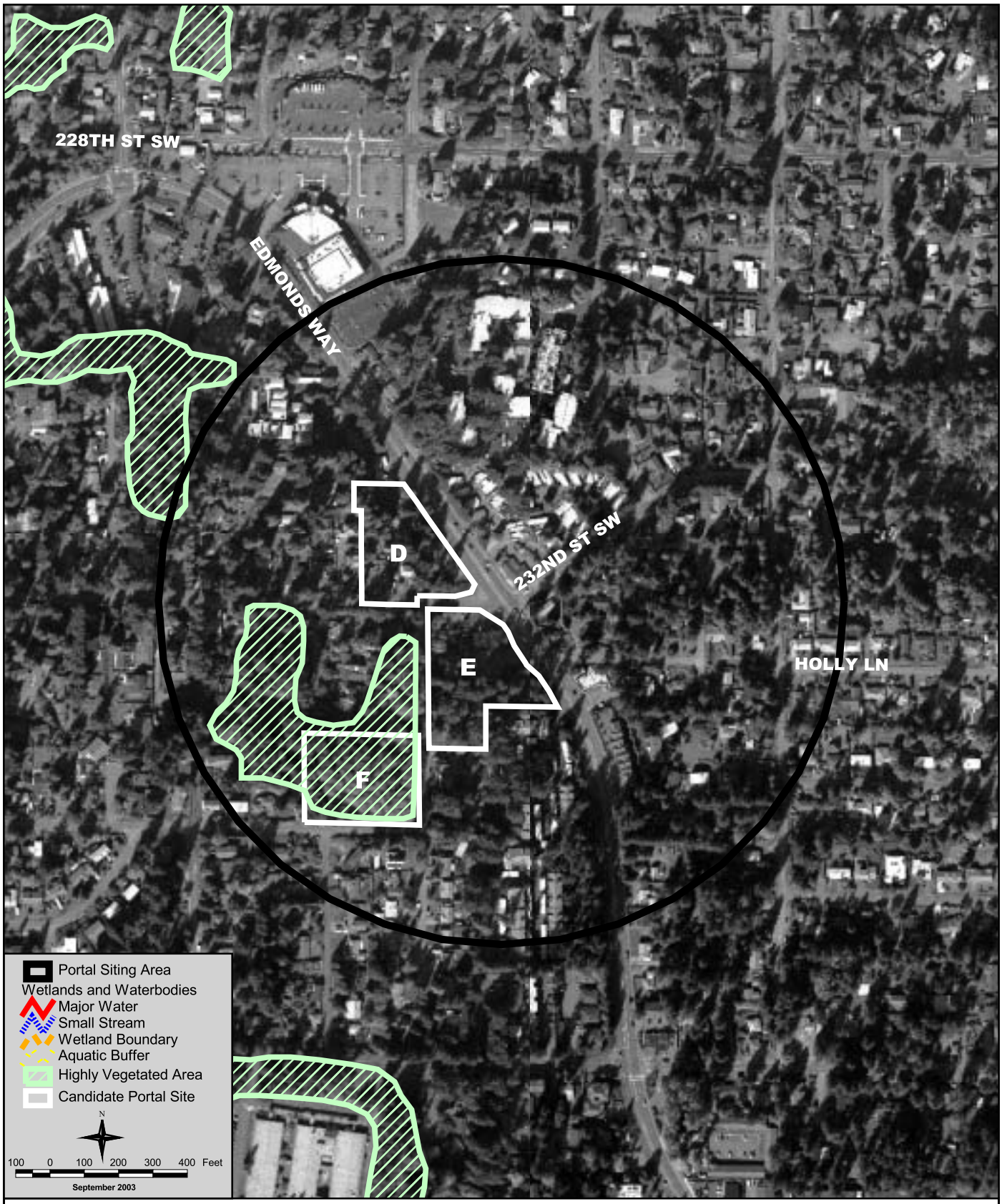
0 200 400 Feet

July 2003

Figure 7-2

Habitat Types on the Unocal Site

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

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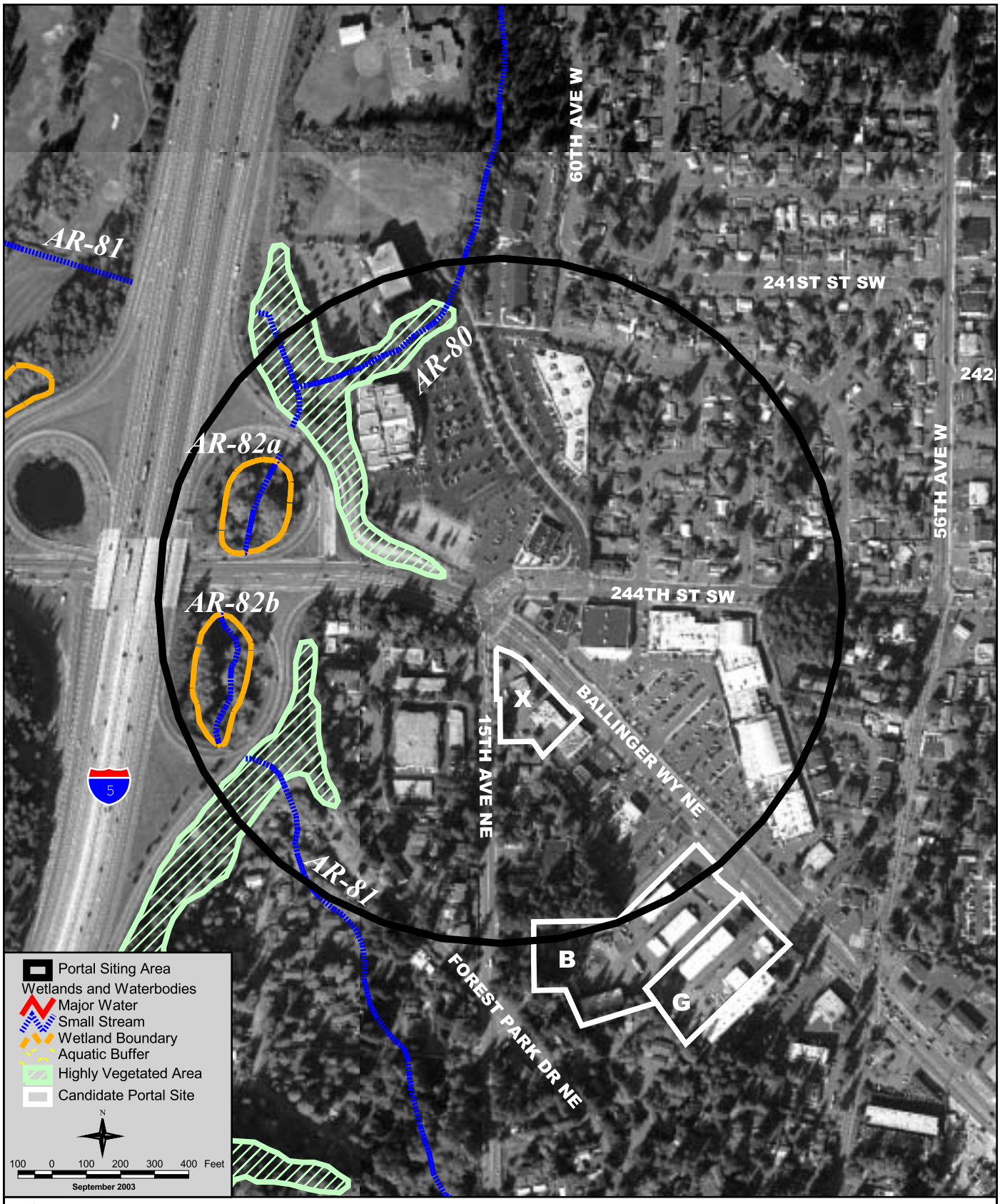
Prepared By: King County WTD GIS

Figure 7-3

Portal Siting Area 3 Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

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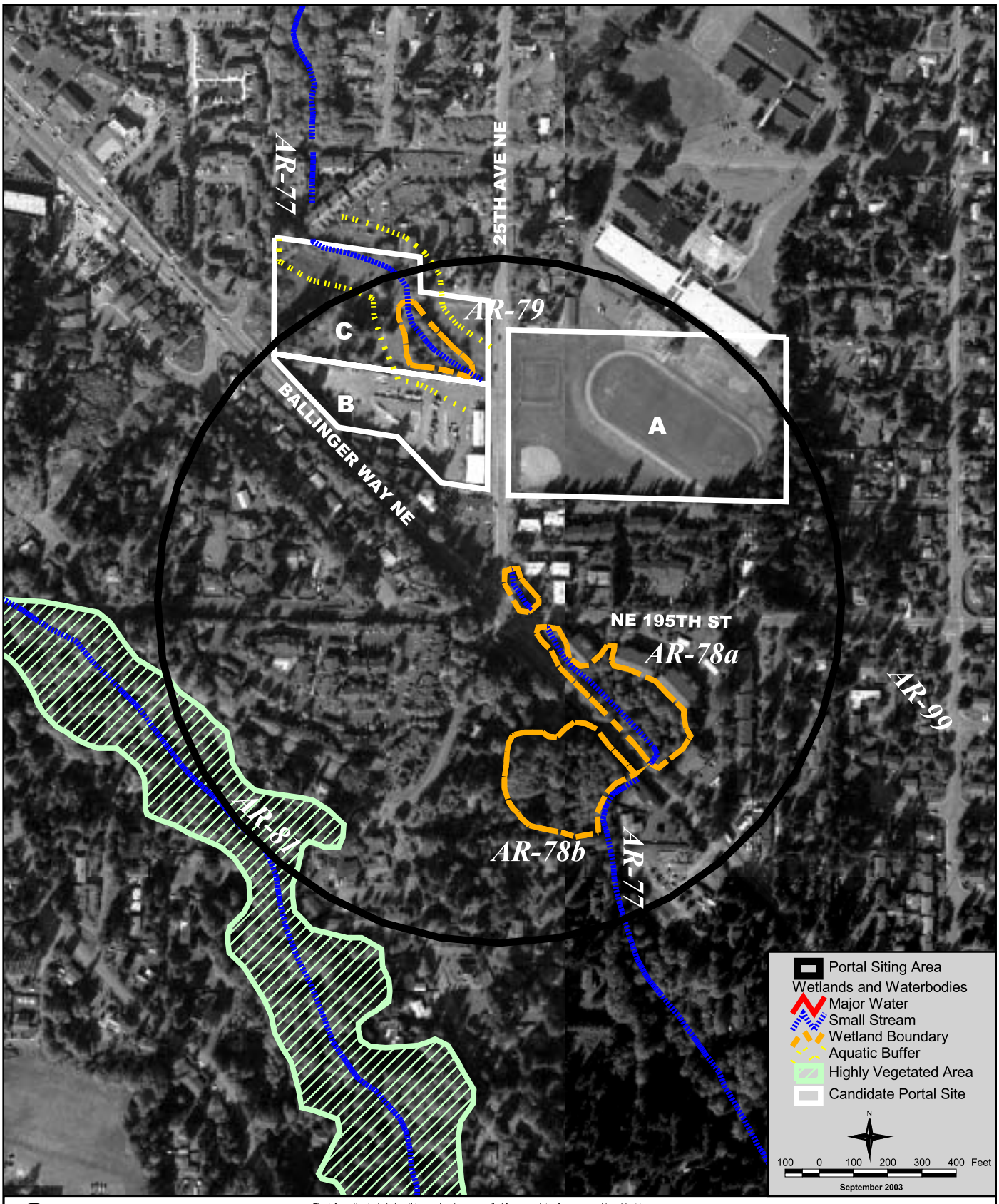
Prepared By: King County WTD GIS

Figure 7-4

Portal Siting Area 5
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

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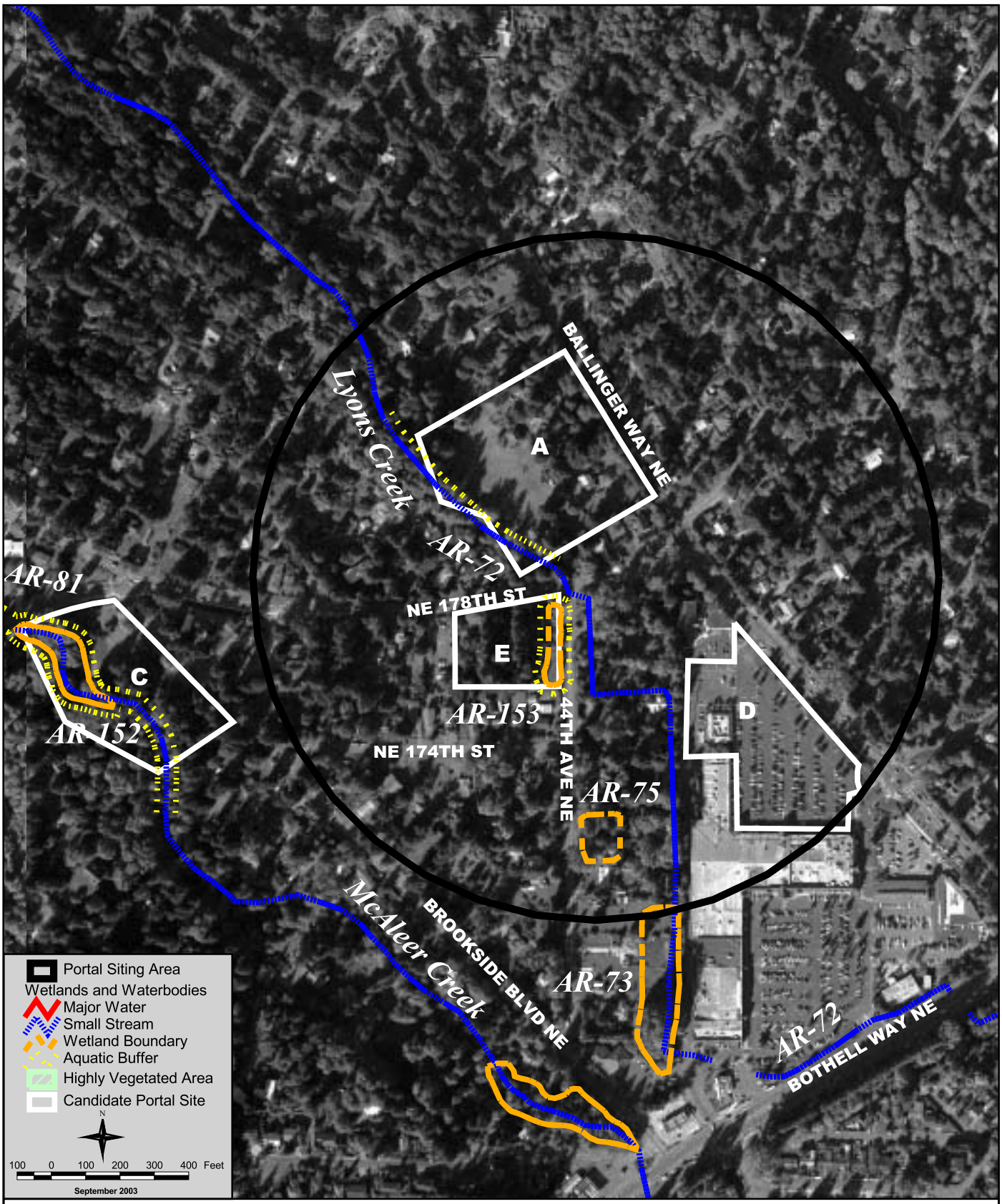
Prepared By: King County WTD GIS

Figure 7-5

Portal Siting Area 7
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

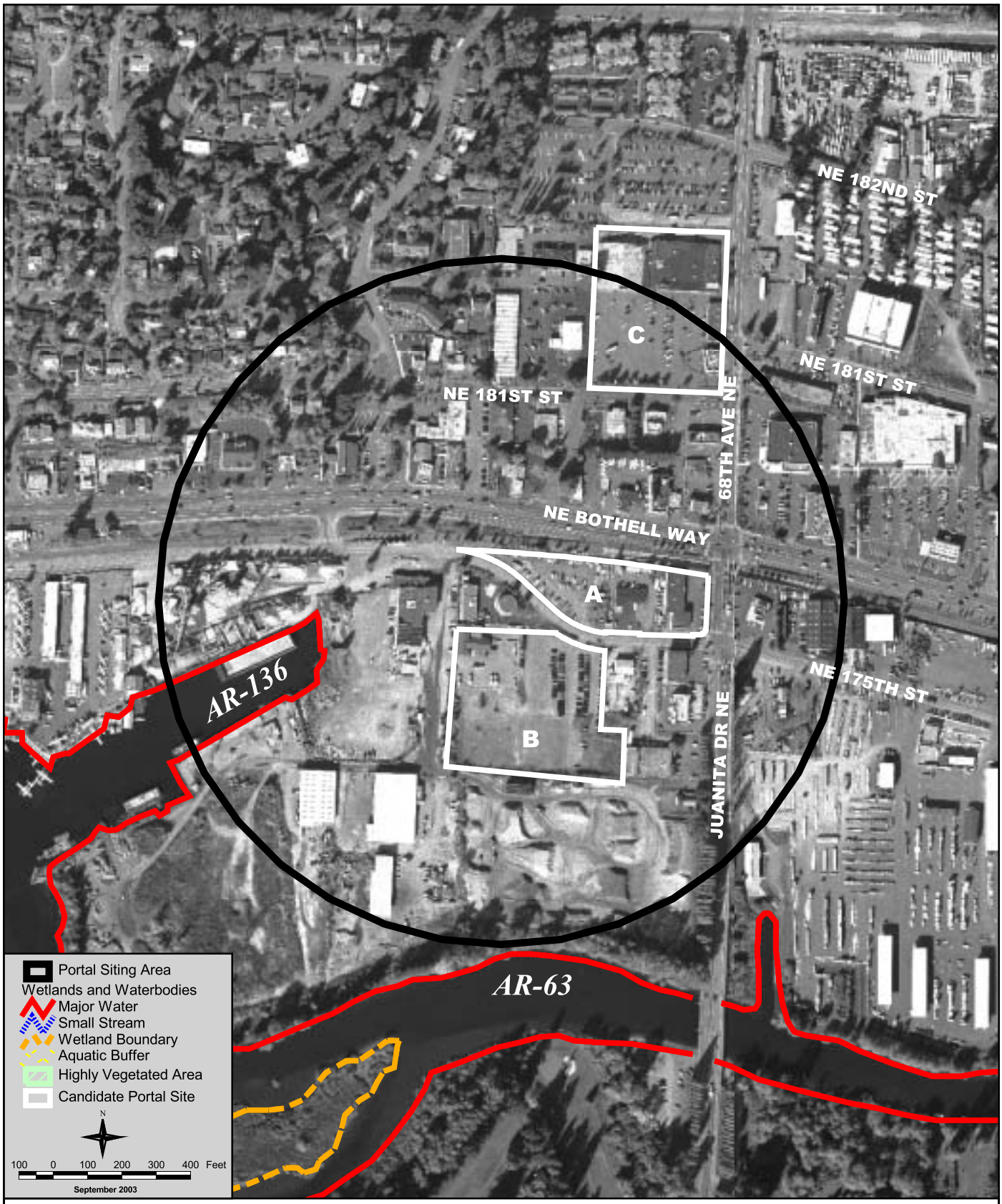
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-6

Portal Siting Area 10 Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
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Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

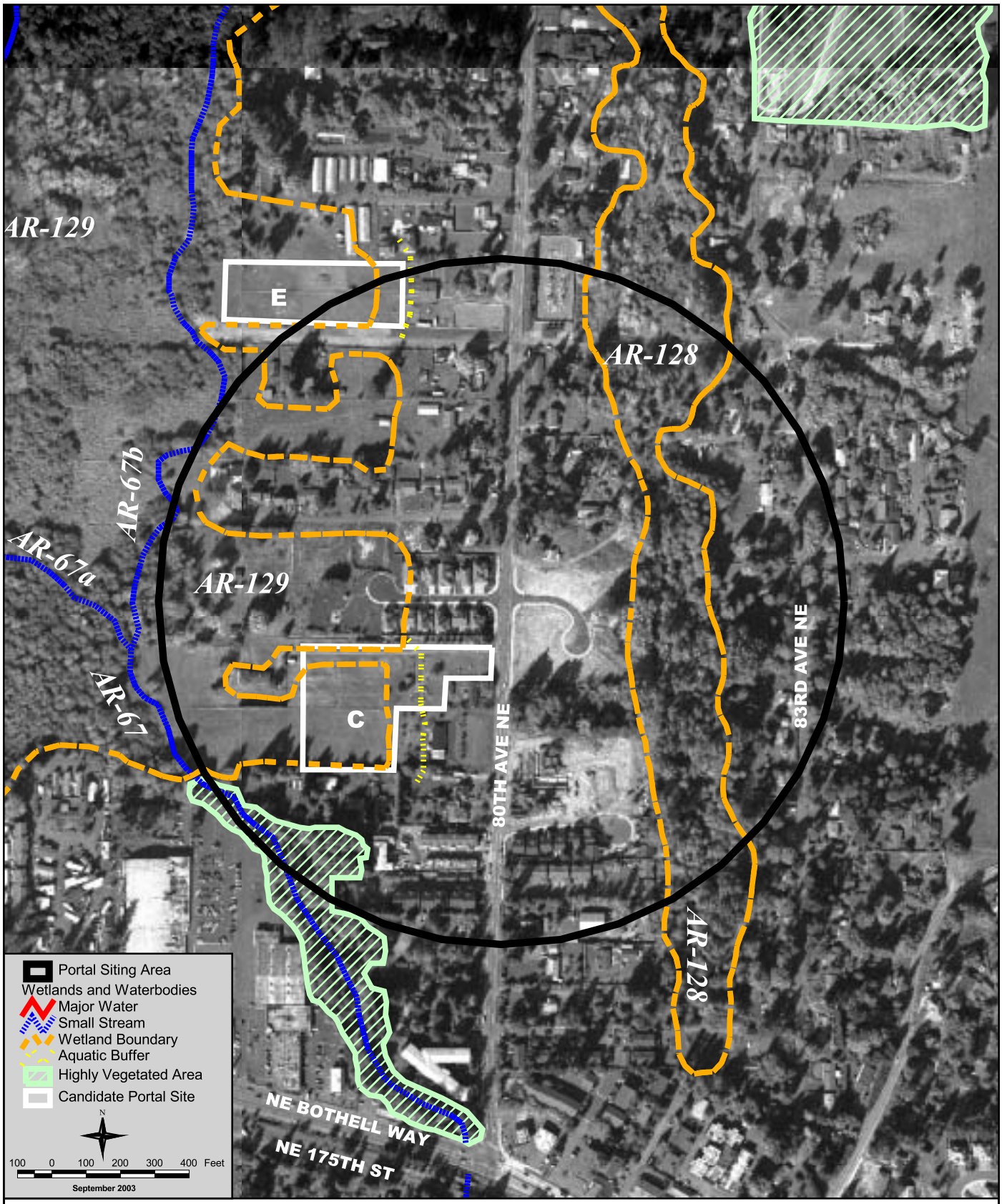
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-7

Portal Siting Area 11
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

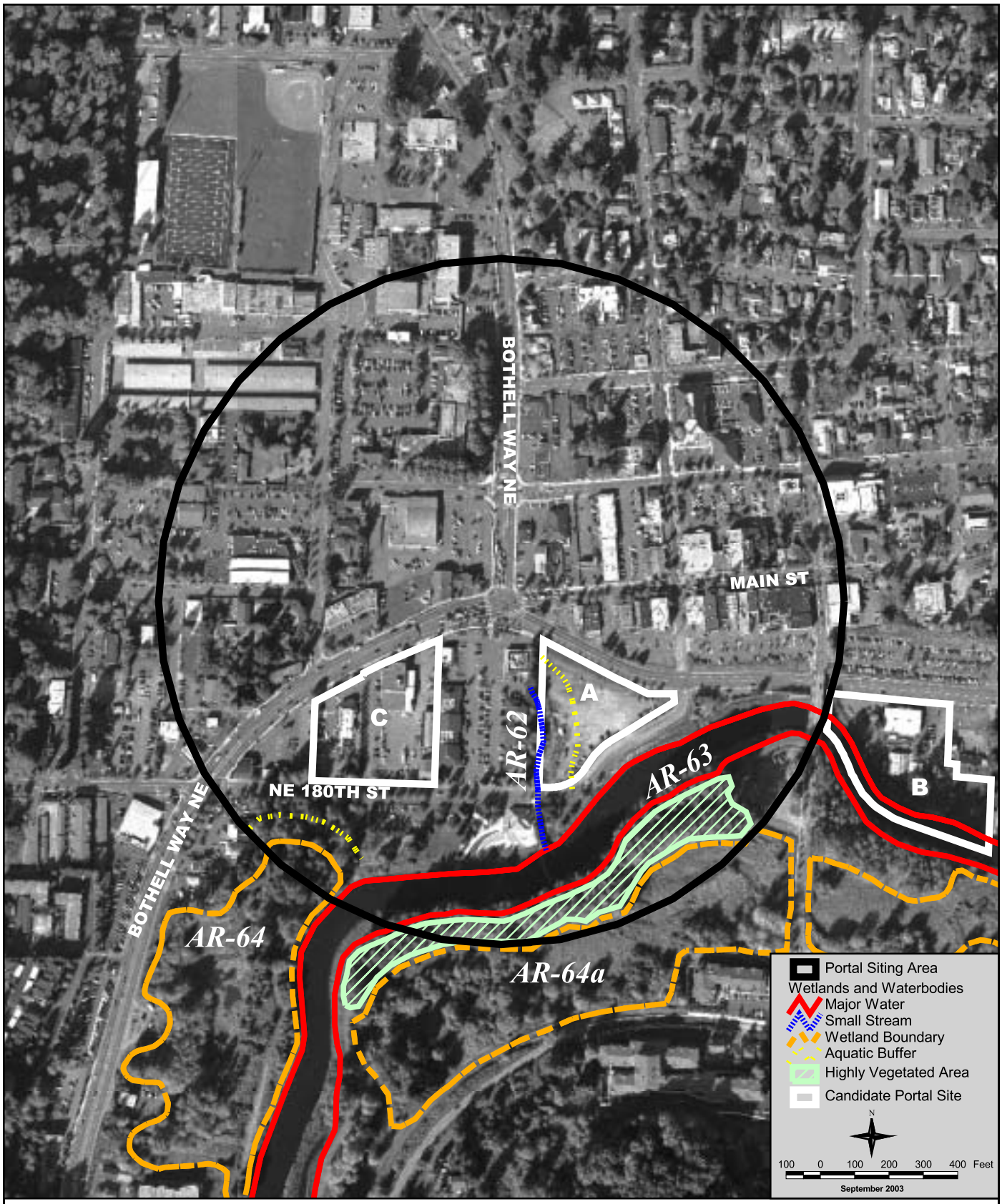
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-8

Portal Siting Area 12 Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

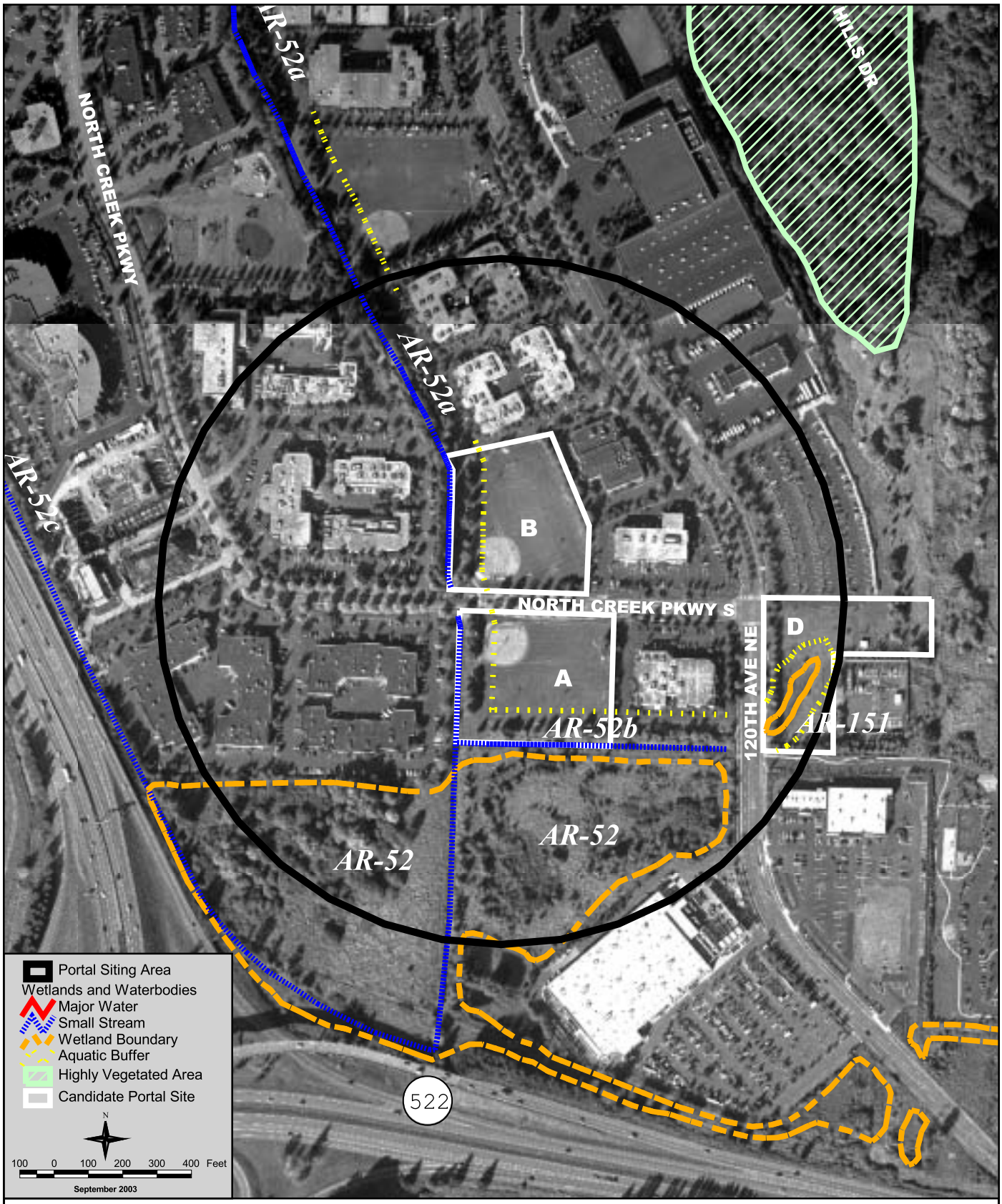
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-9

Portal Siting Area 13
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

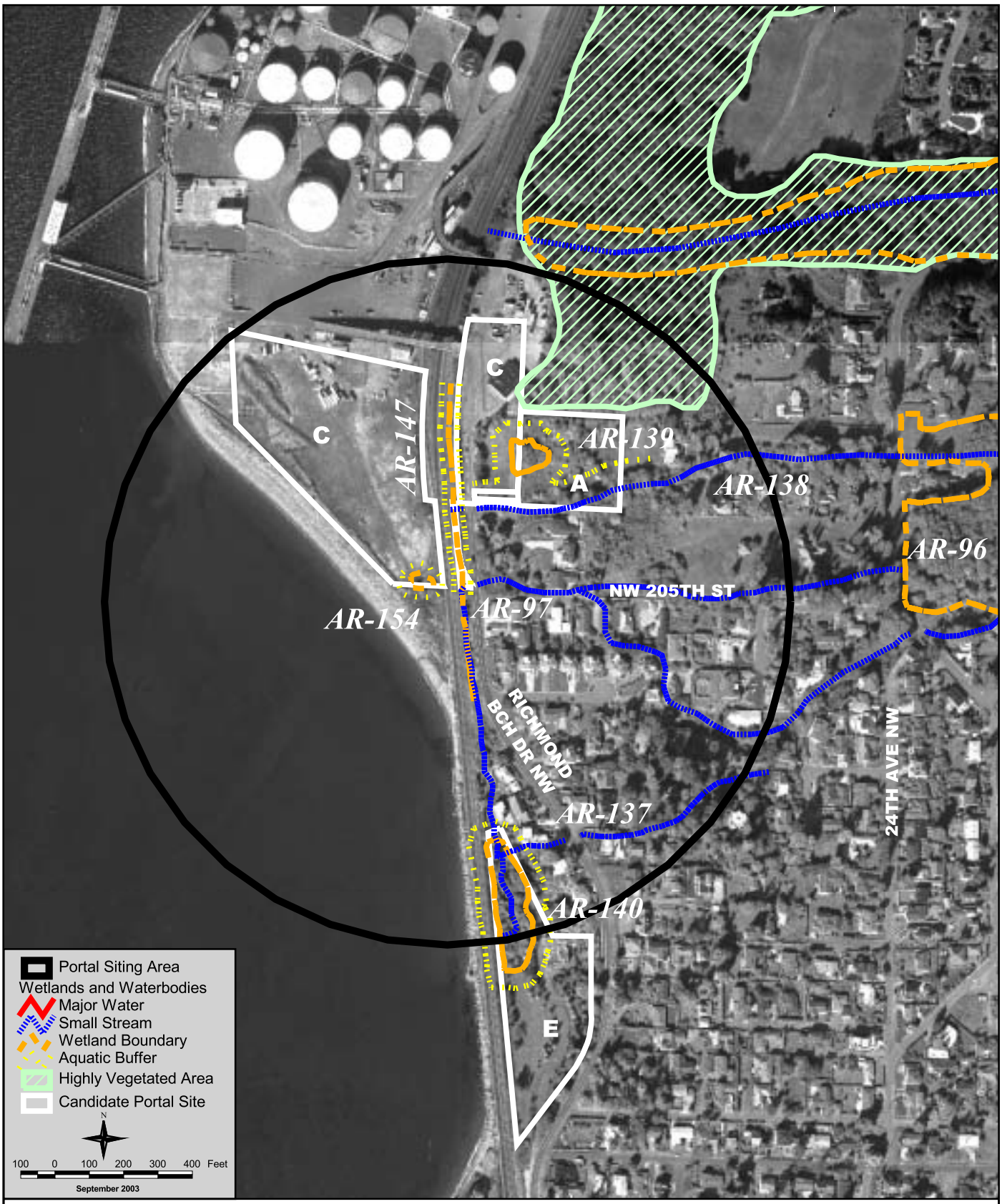
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-10

Portal Siting Area 14
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

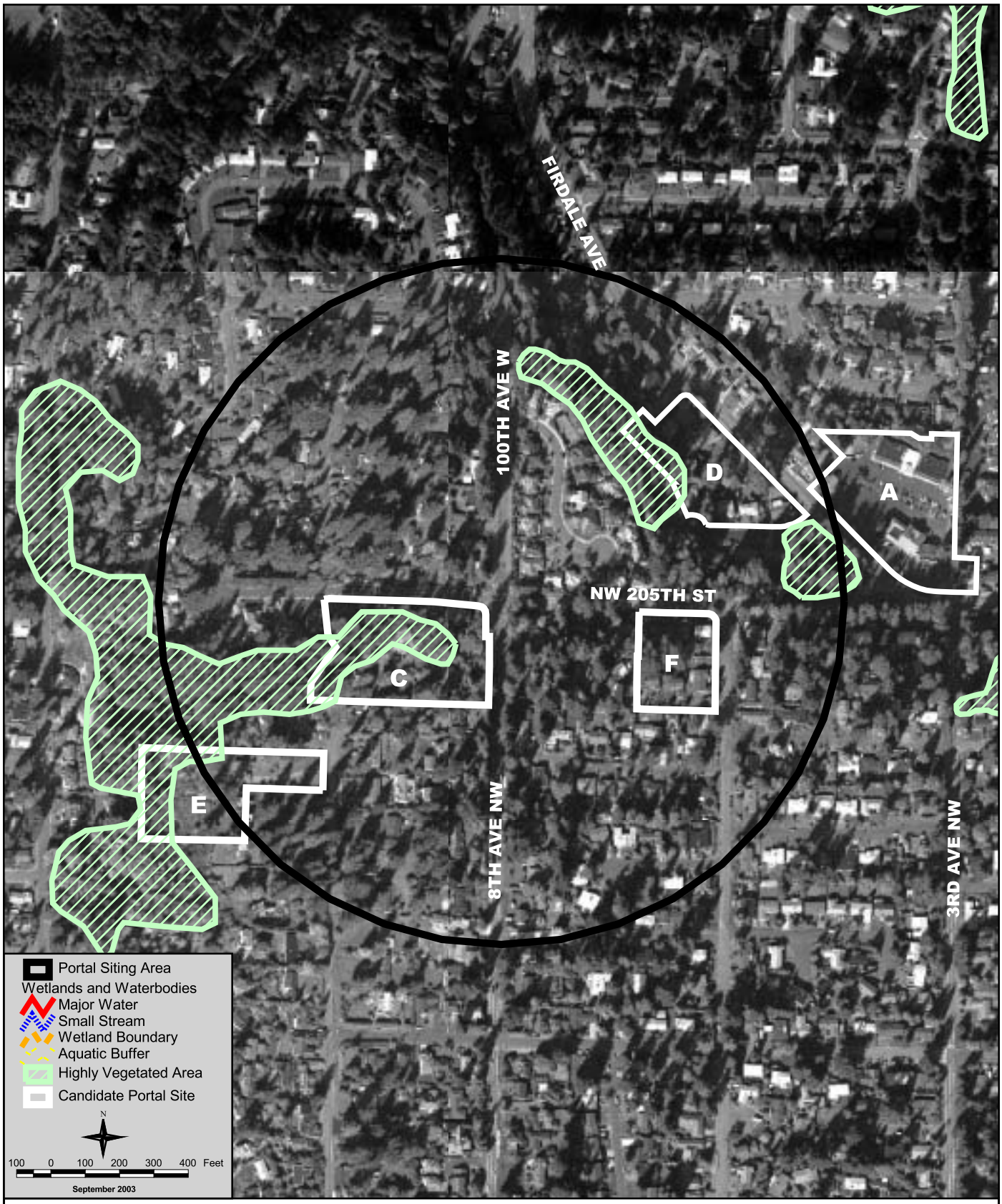
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-11

Portal Siting Area 19
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

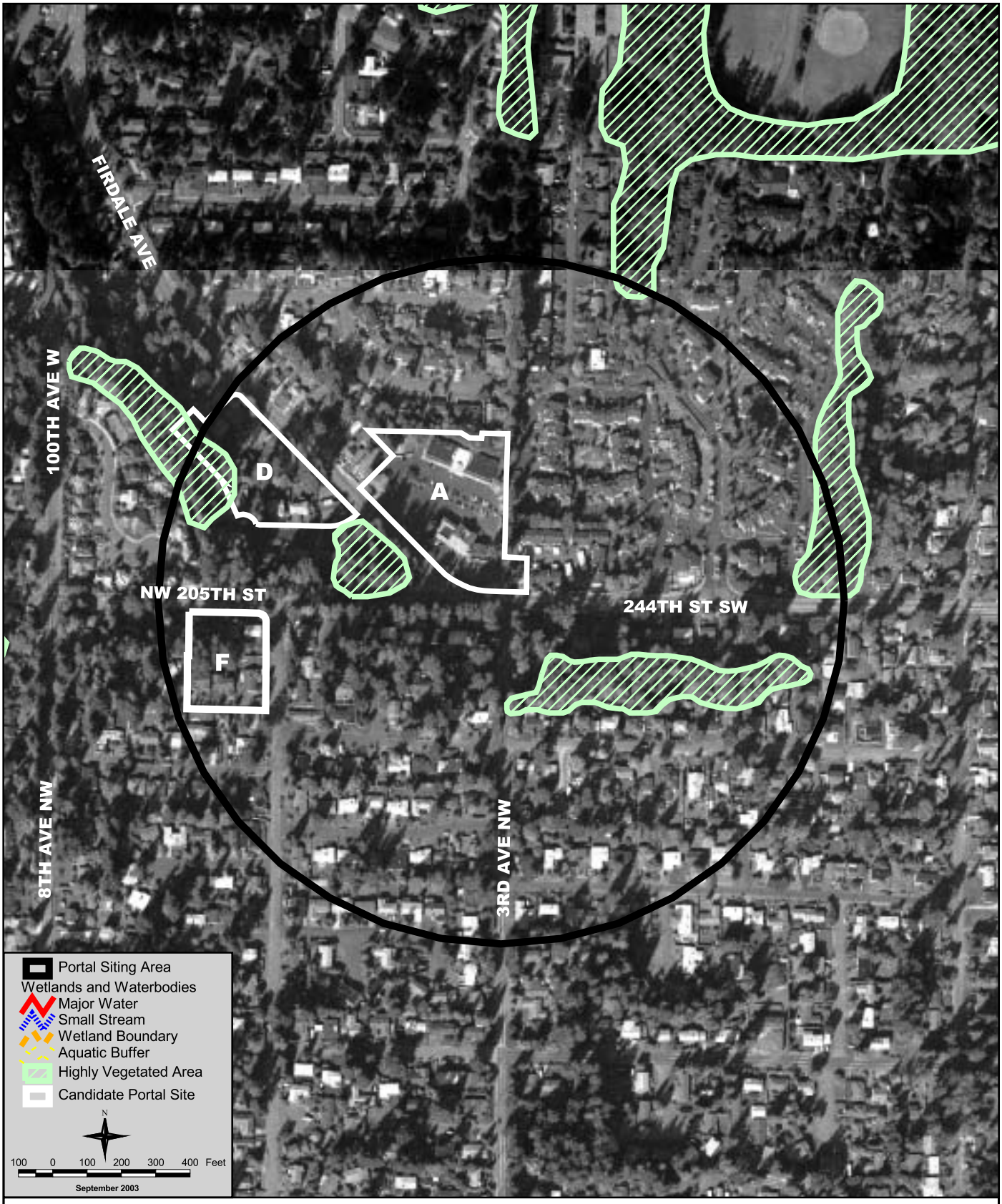
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-12

Portal Siting Area 22
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

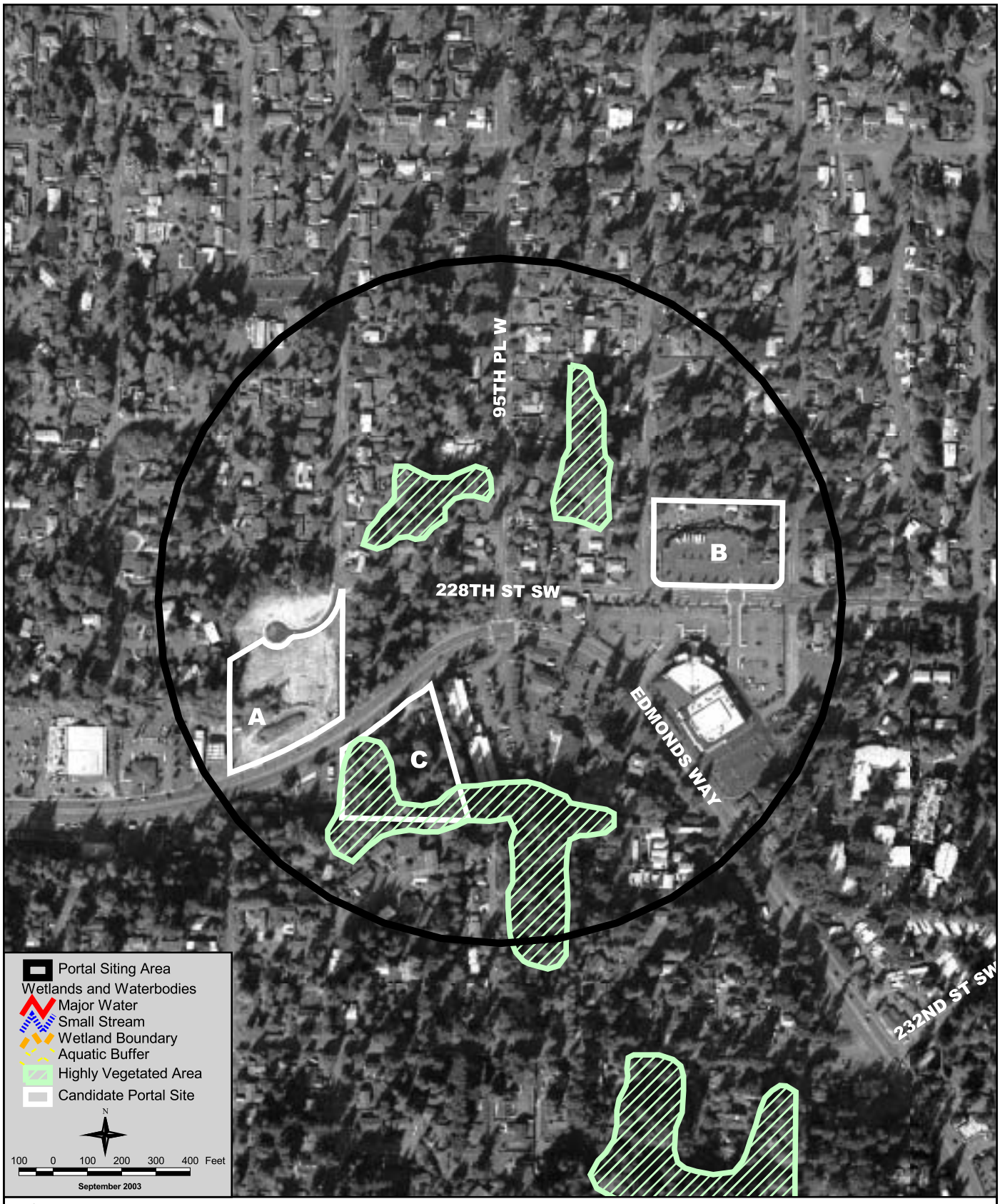
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-13

Portal Siting Area 23 Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

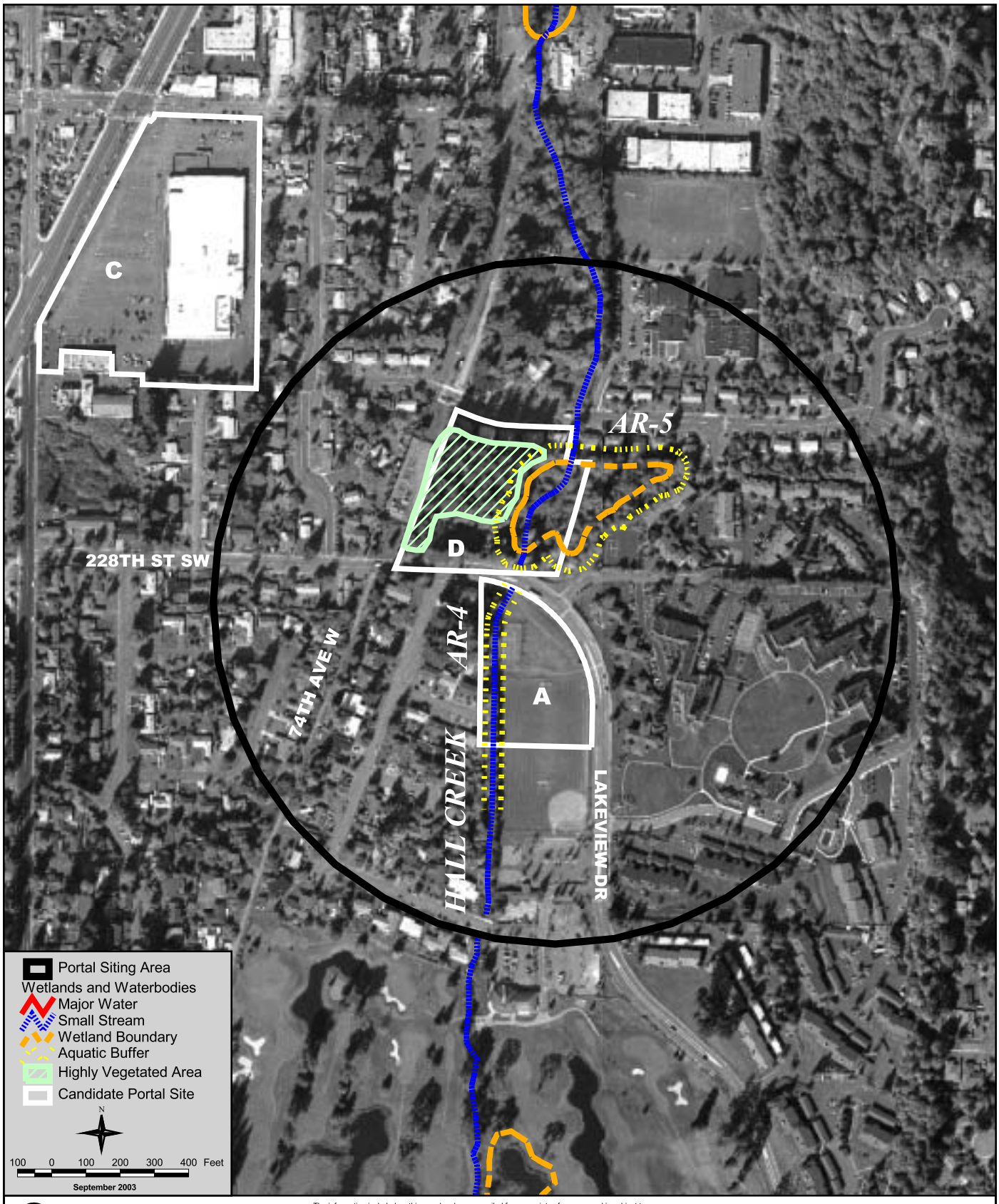
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-14

Portal Siting Area 24
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

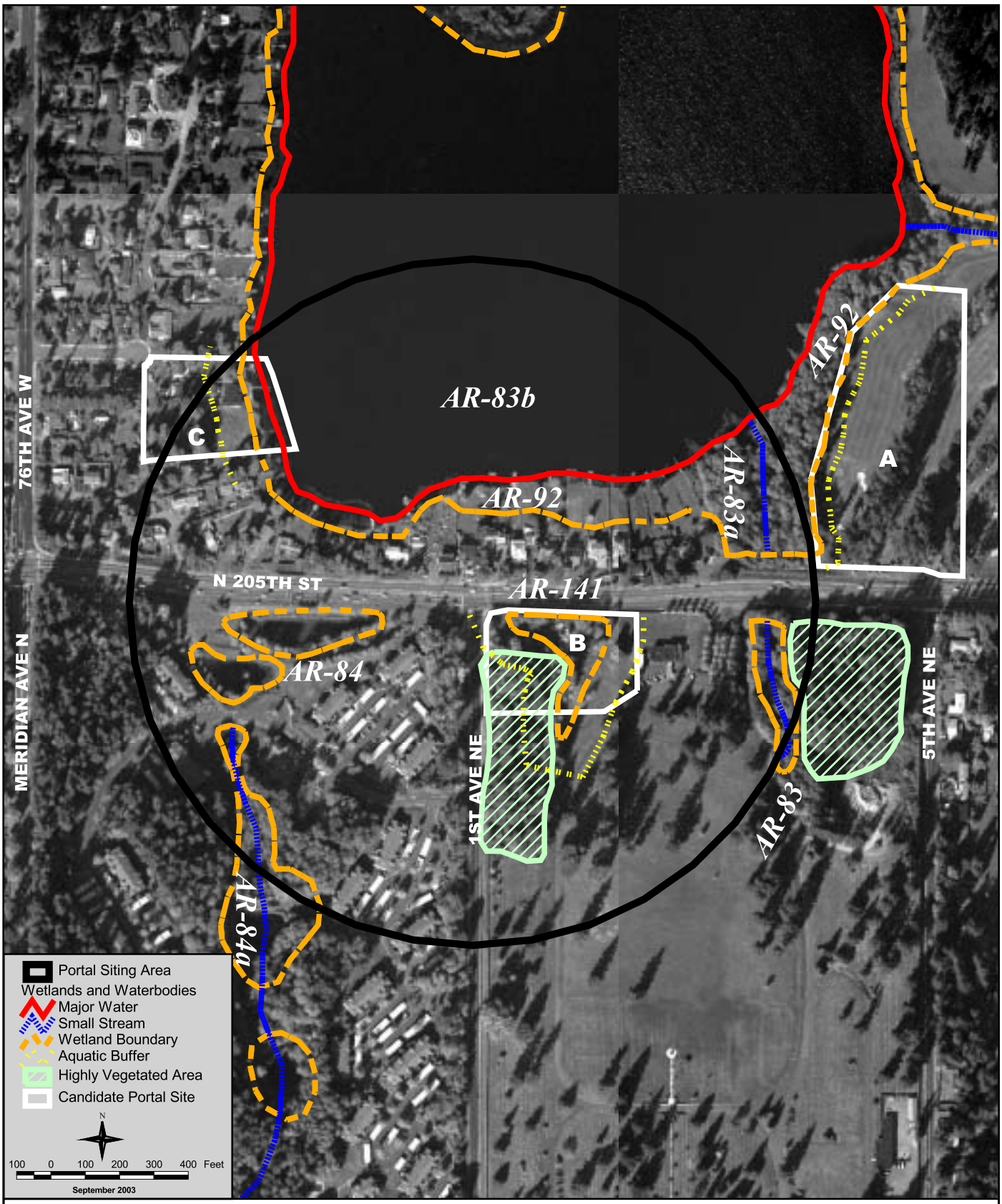
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-15

Portal Siting Area 26
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

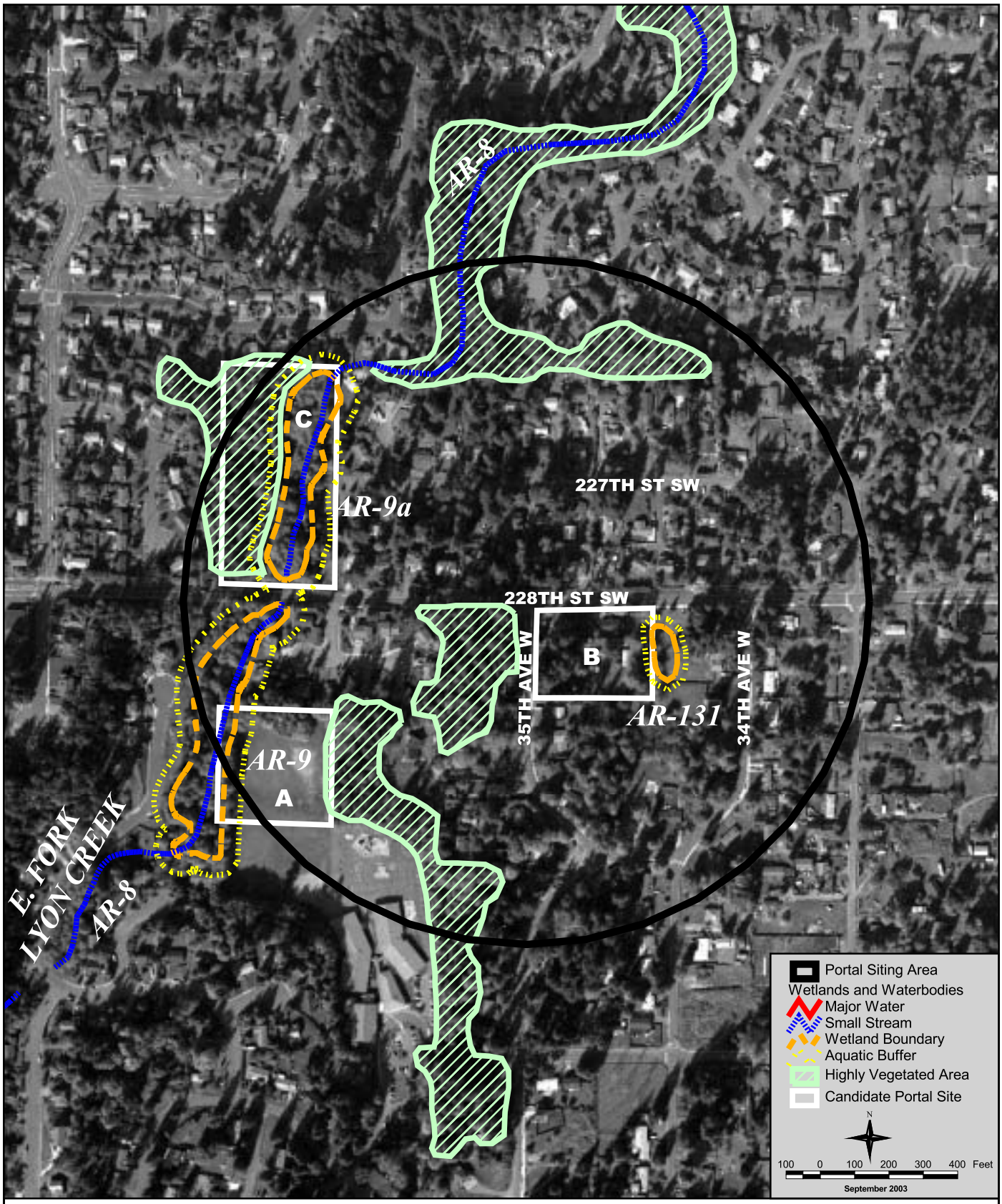
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-16

Portal Siting Area 27
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

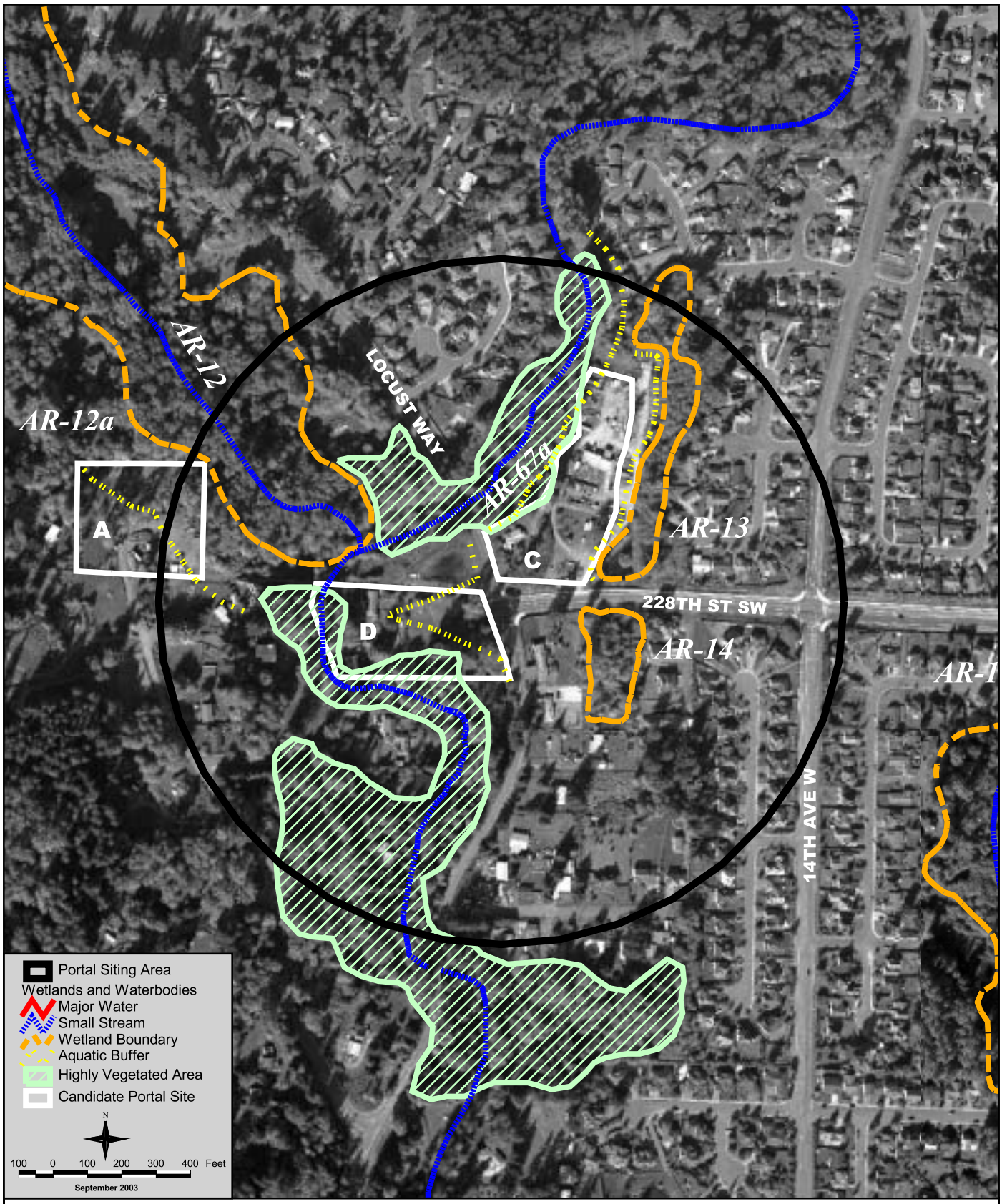
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-17

Portal Siting Area 30 Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

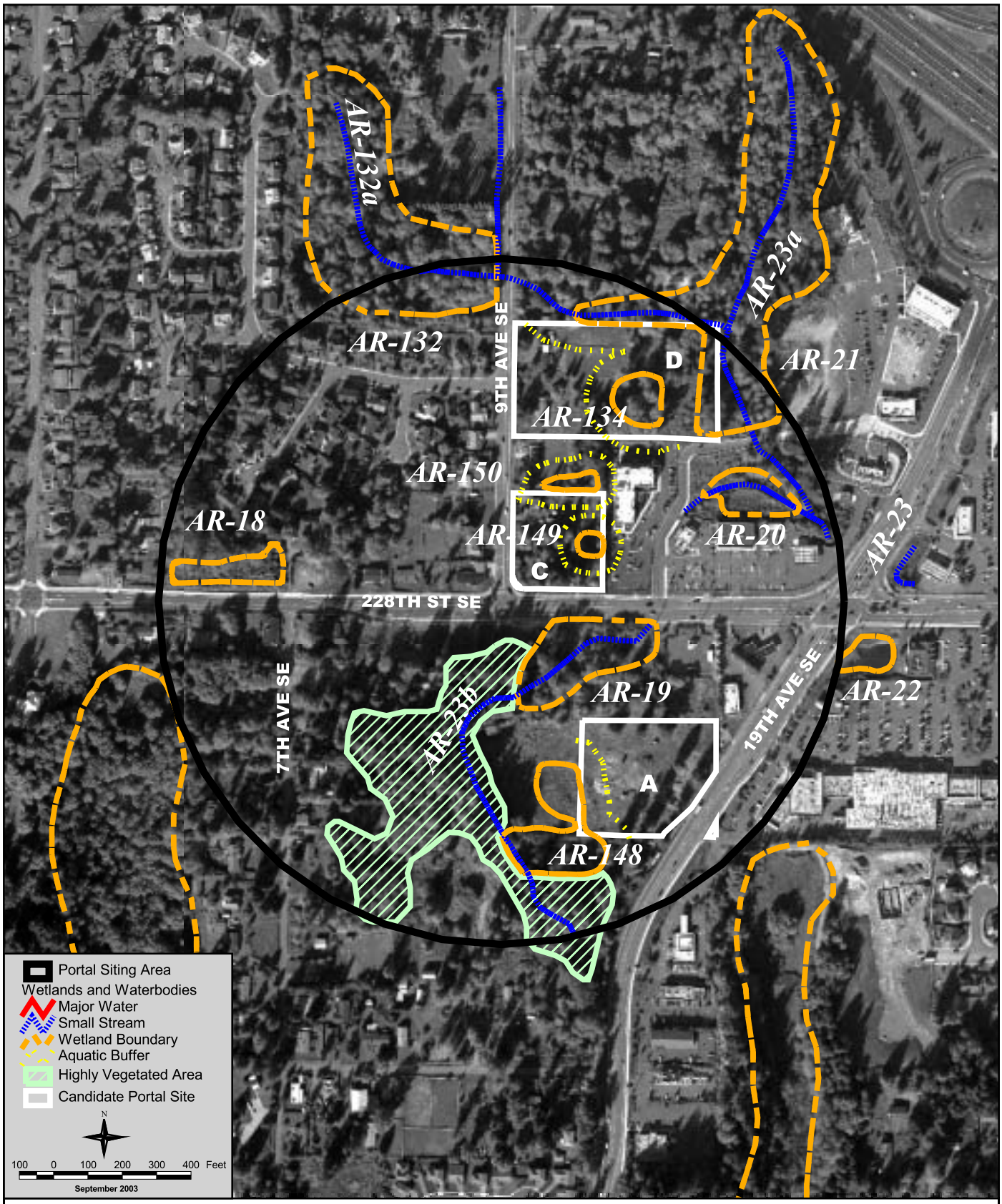
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-18

Portal Siting Area 33
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

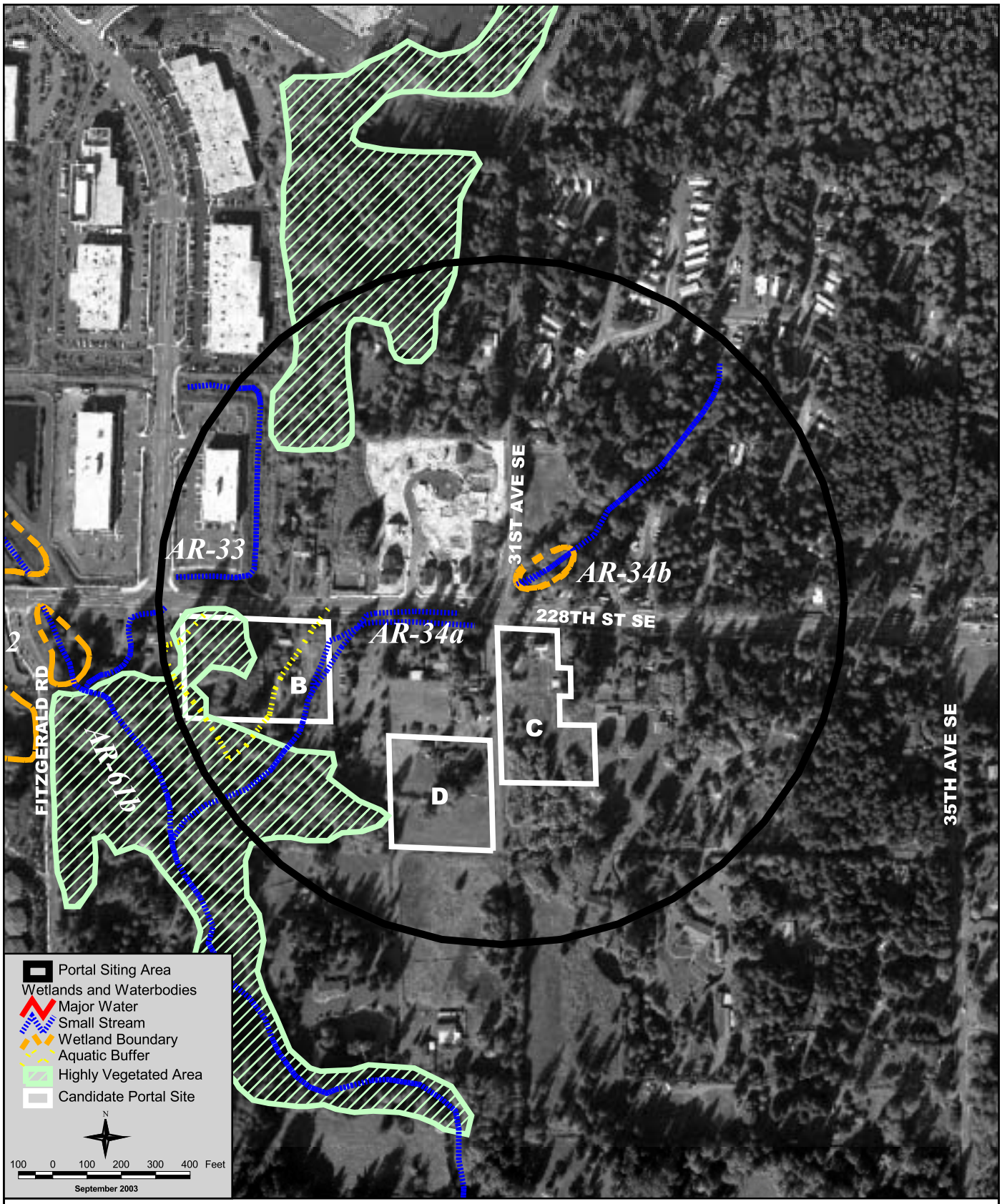
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-19

Portal Siting Area 37
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

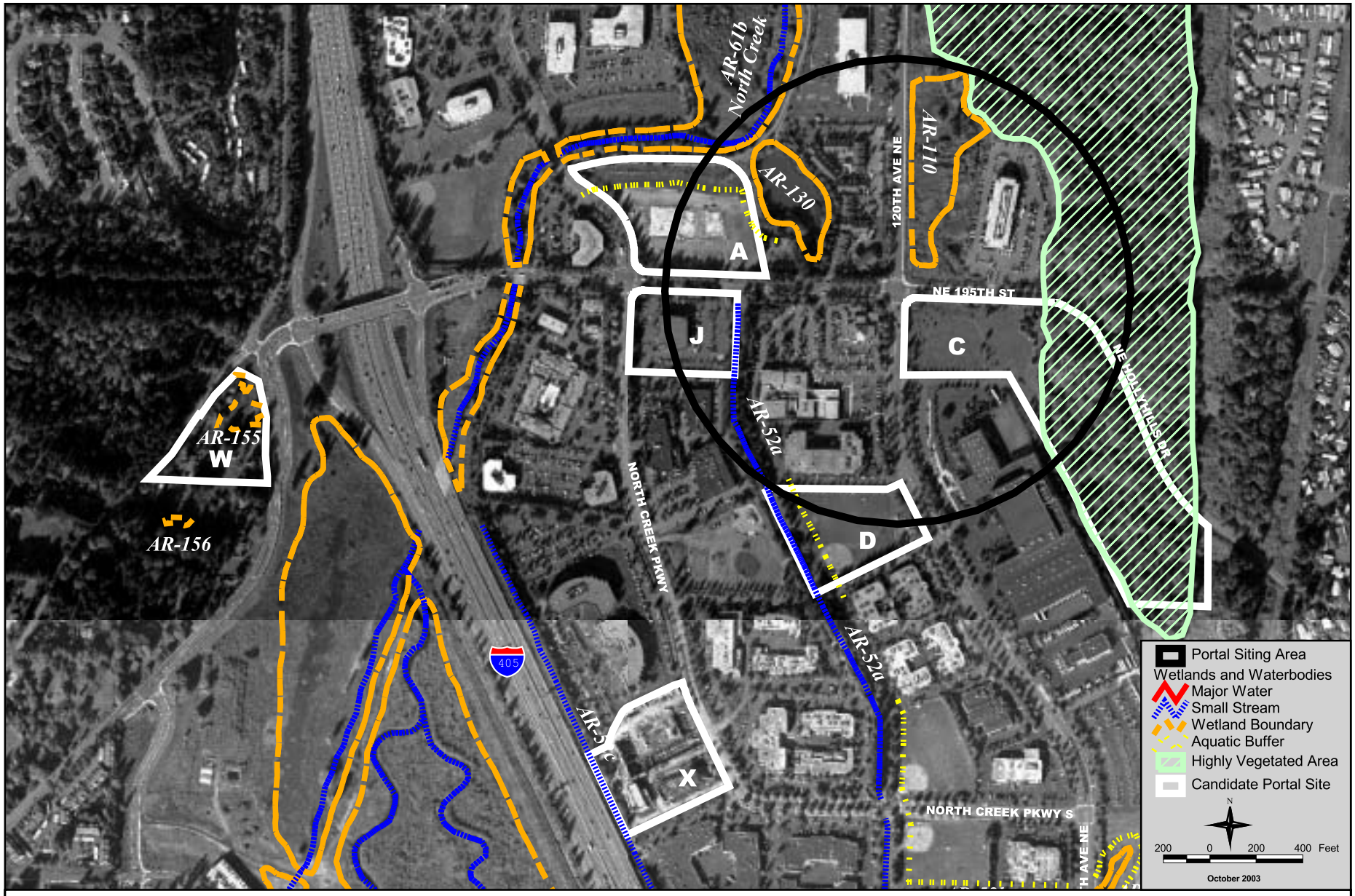
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-20

Portal Siting Area 39
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment
Division

Data Sources: Herrera, 2003; King County

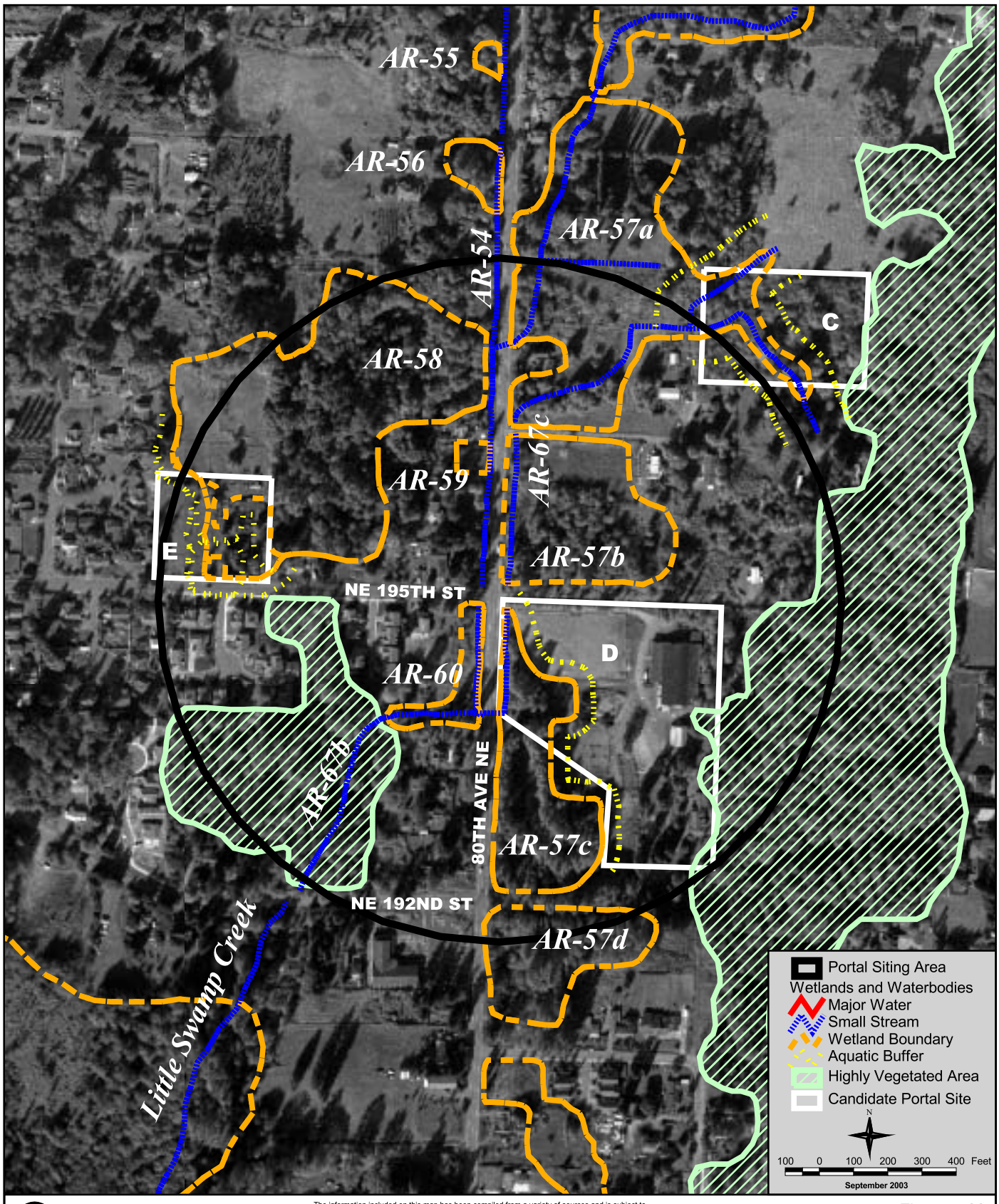
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-21

Portal Siting Area 41
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: Herrera, 2003; King County

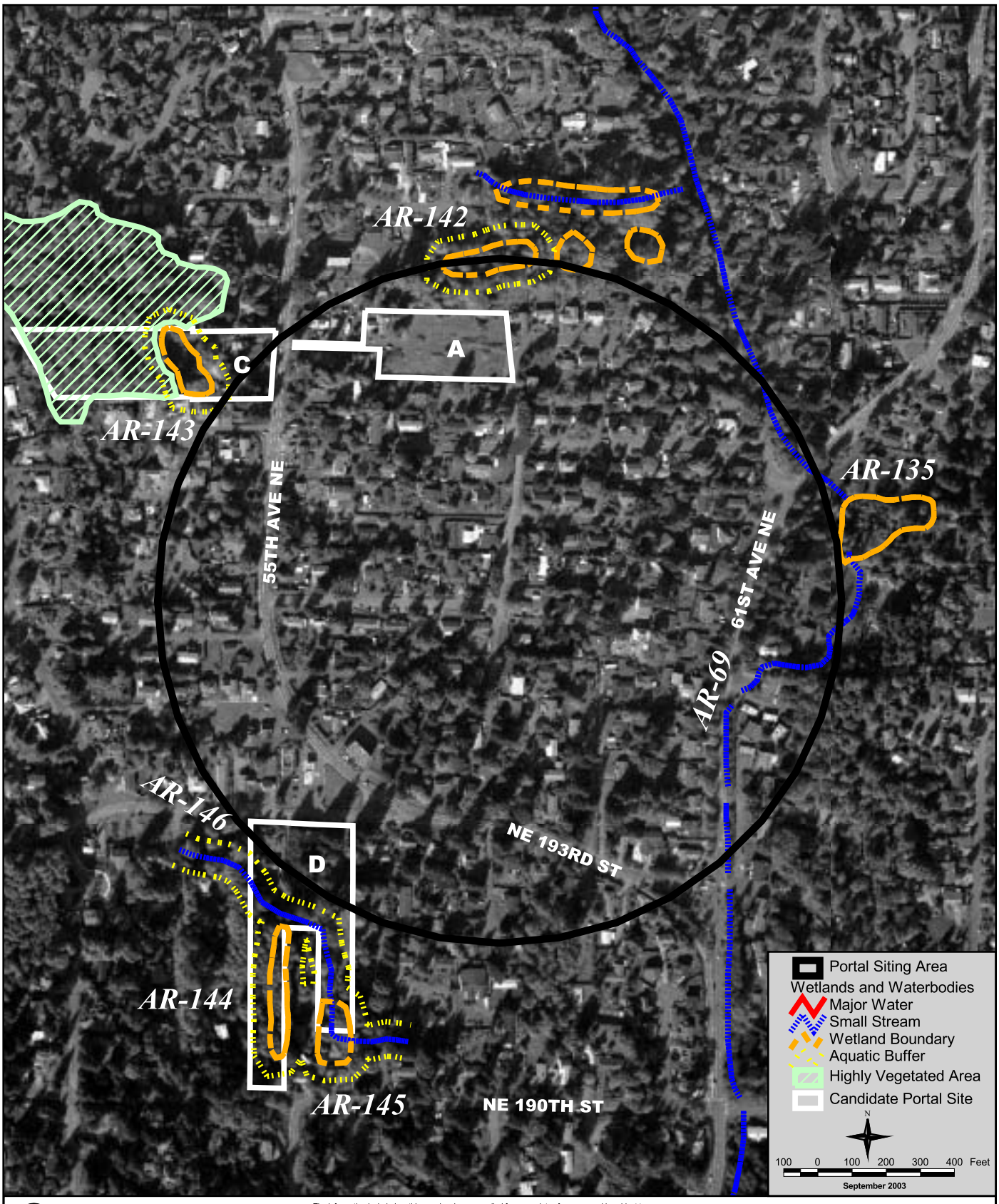
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-22

Portal Siting Area 44
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
Department of
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Data Sources: Herrera, 2003; King County

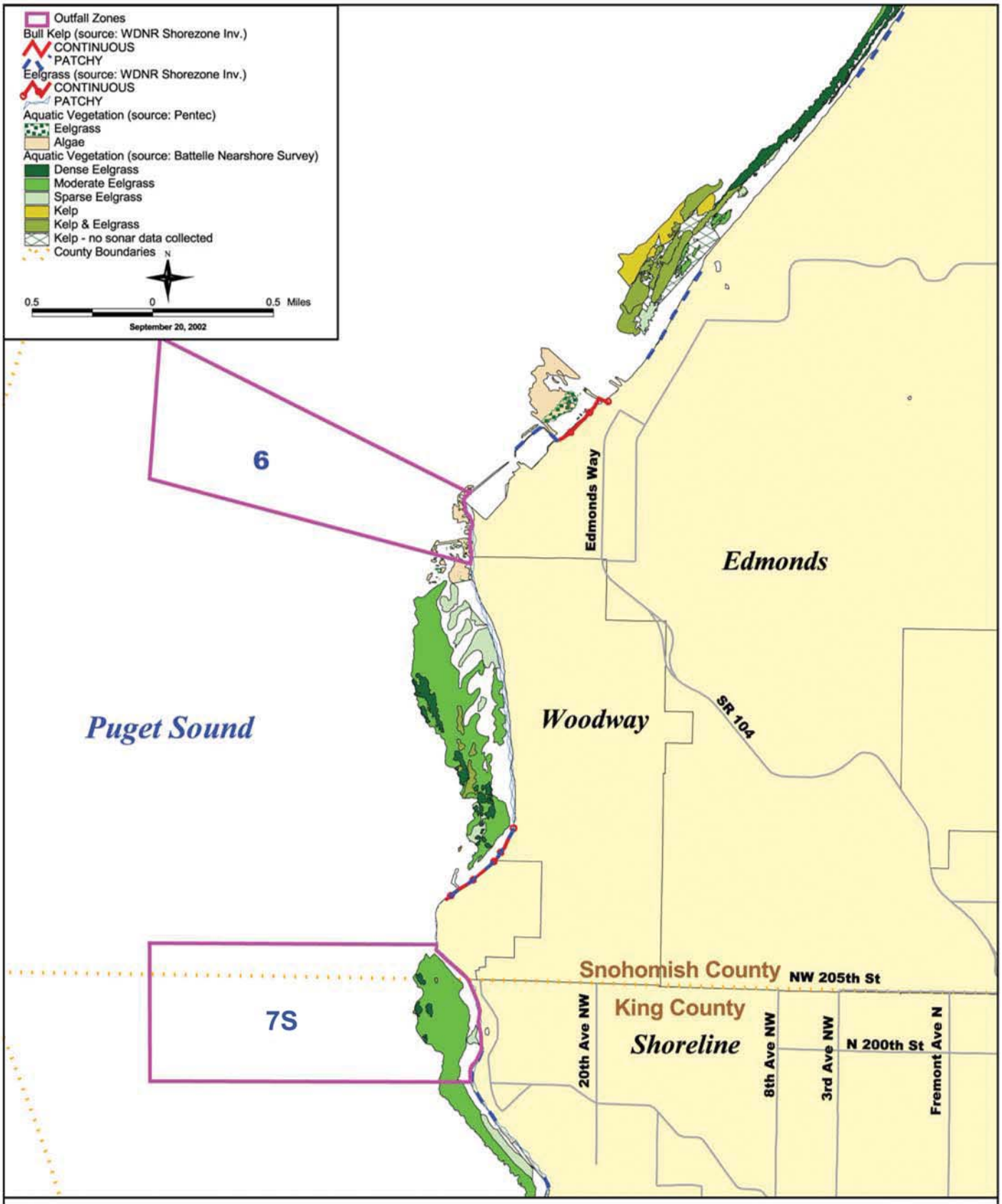
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels2.apr Shari Cross

Prepared By: King County WTD GIS

Figure 7-23

Portal Siting Area 45
Sensitive Areas

BRIGHTWATER FINAL EIS



King County
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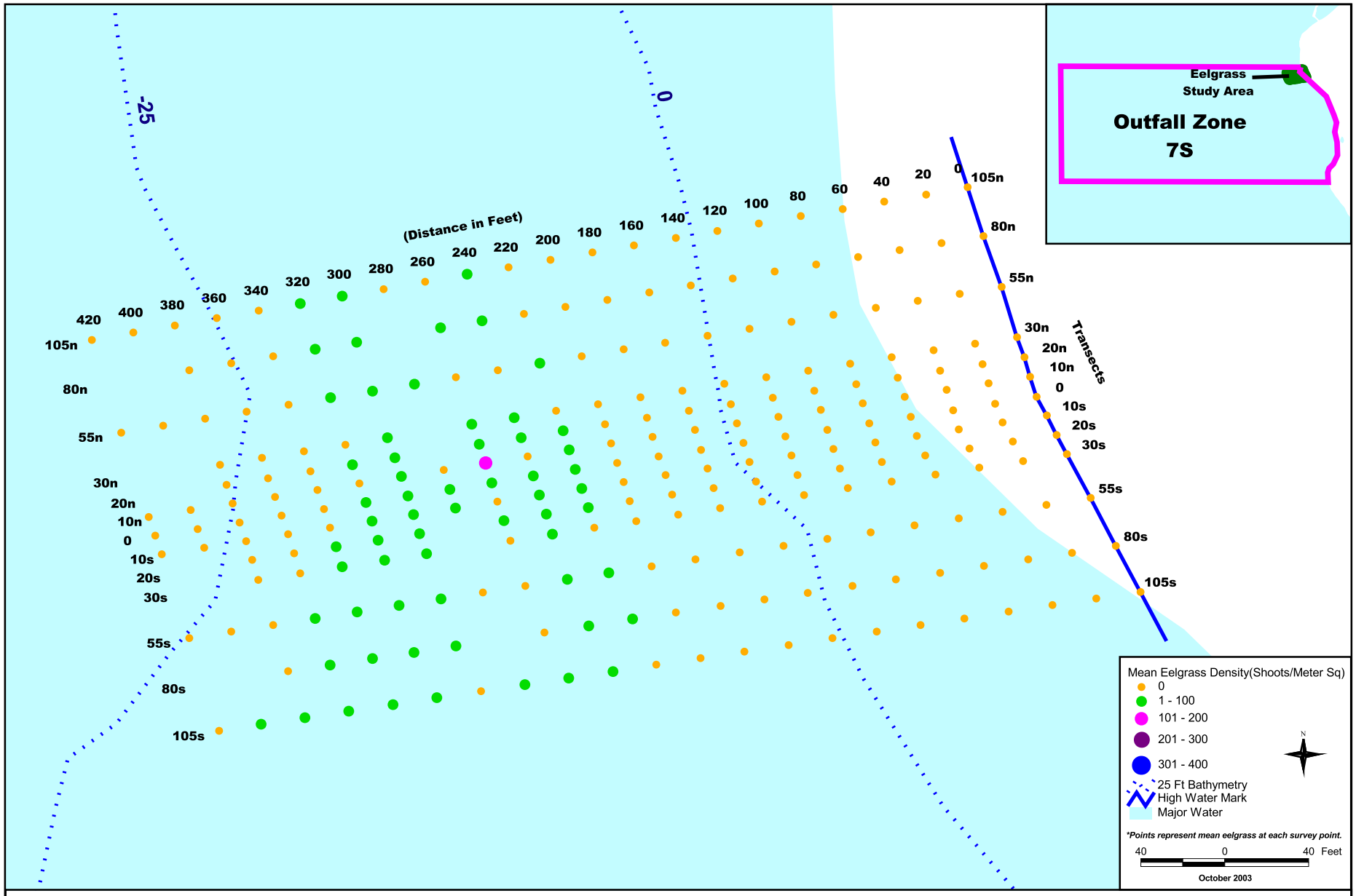
Wastewater Treatment Division

Figure 7-24
Submerged Aquatic Vegetation in Outfall Zones and Vicinity
BRIGHTWATER FINAL EIS



King County
Department of
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Wastewater Treatment
Division

Prepared By: King County WTD GIS

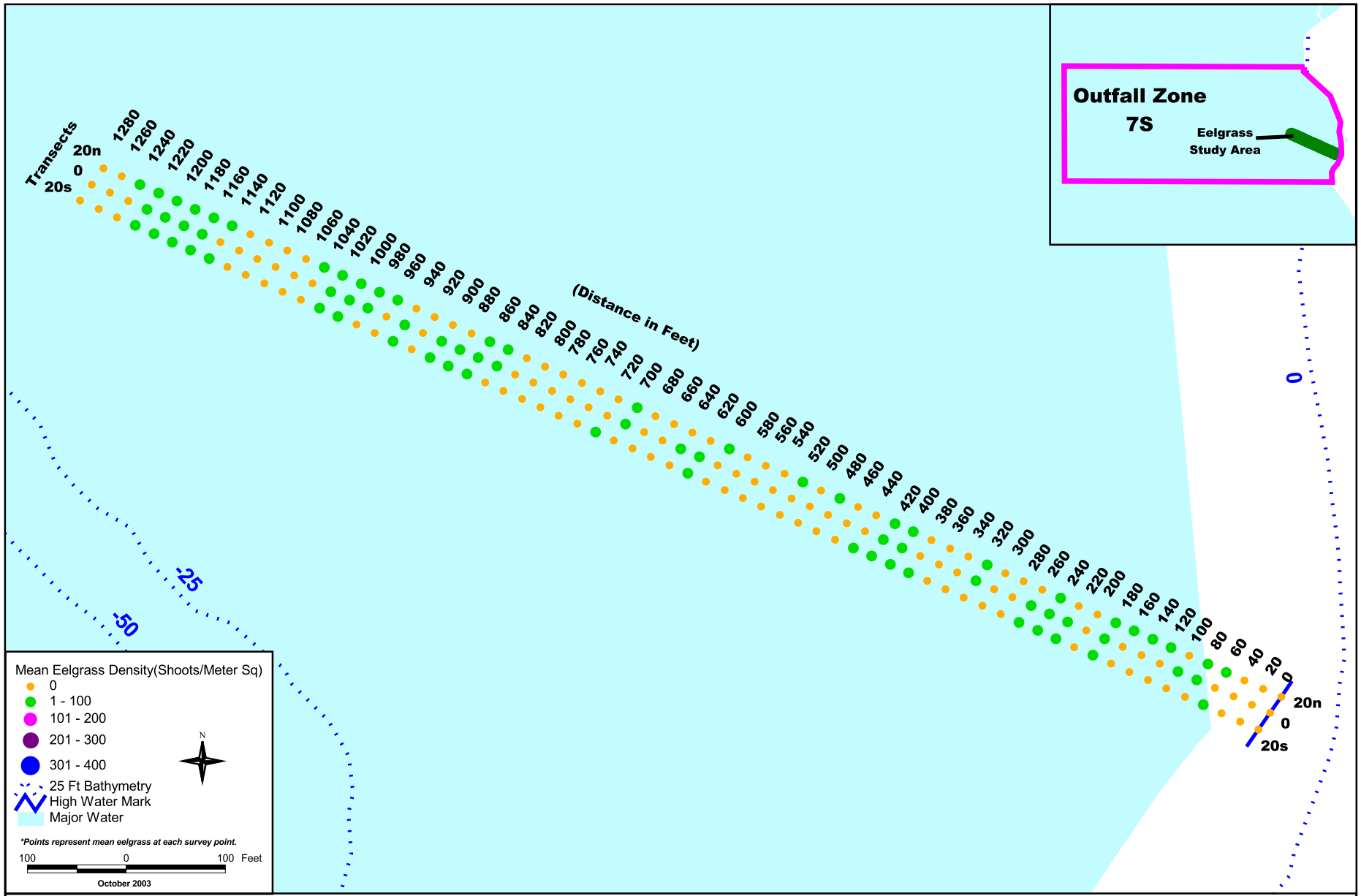
Data Sources: Parametrix, Inc.

File Name: dnrp1:\WTD\Projects\MOSS\projects\eelgrass_transects.apr Shari Cross

Figure 7-25

Outfall Zone 7s - Point Wells
Mean Eelgrass Density

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment
Division

Prepared By: King County WTD GIS

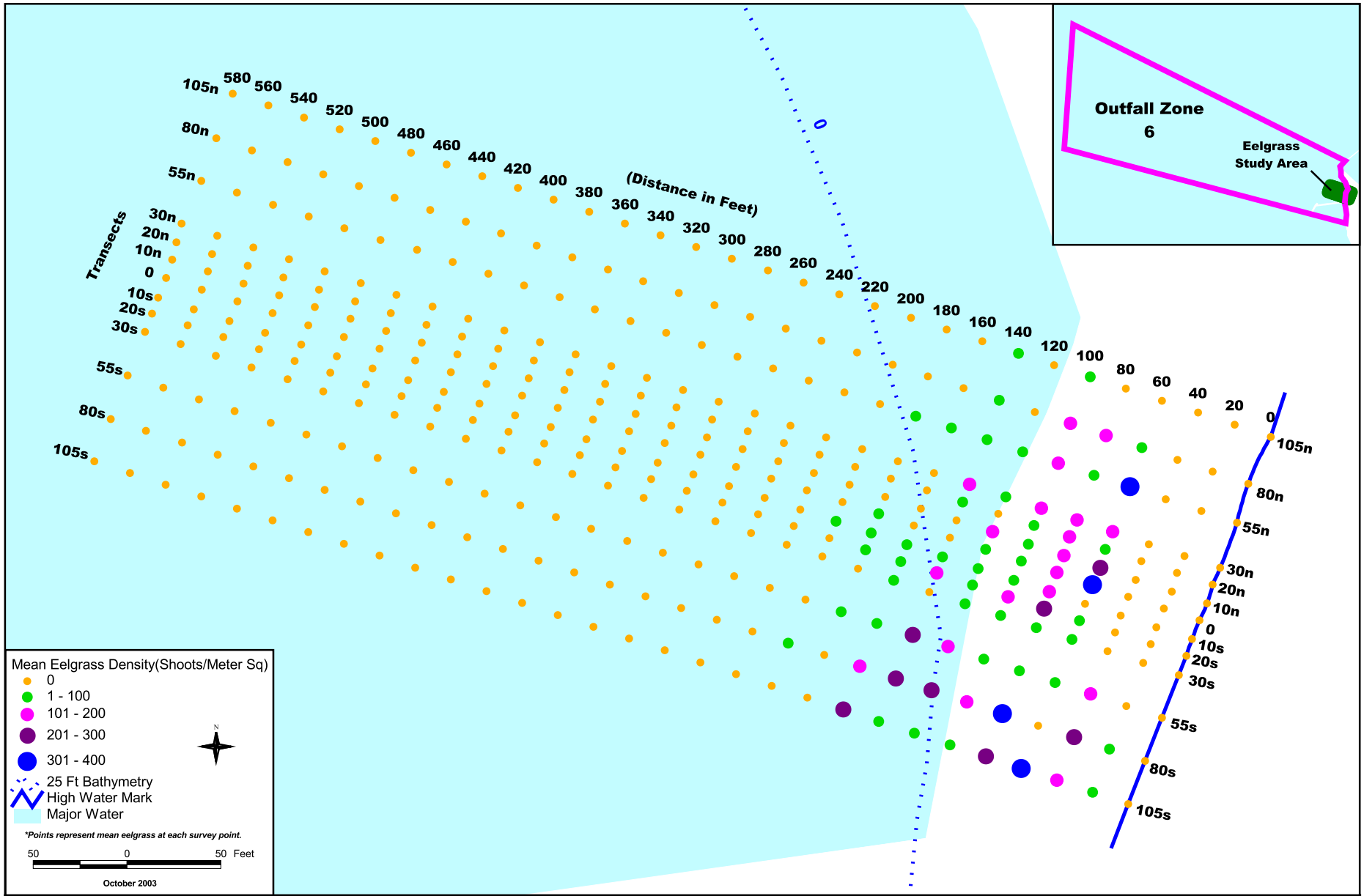
Data Sources: Parametrix, Inc.

File Name: dnrp1:\WTD\Projects\MOSS\projects\eelgrass_transects.apr Shari Cross

Figure 7-26

Outfall Zone 7s - Richmond Beach
Mean Eelgrass Density

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment
Division

Prepared By: King County WTD GIS

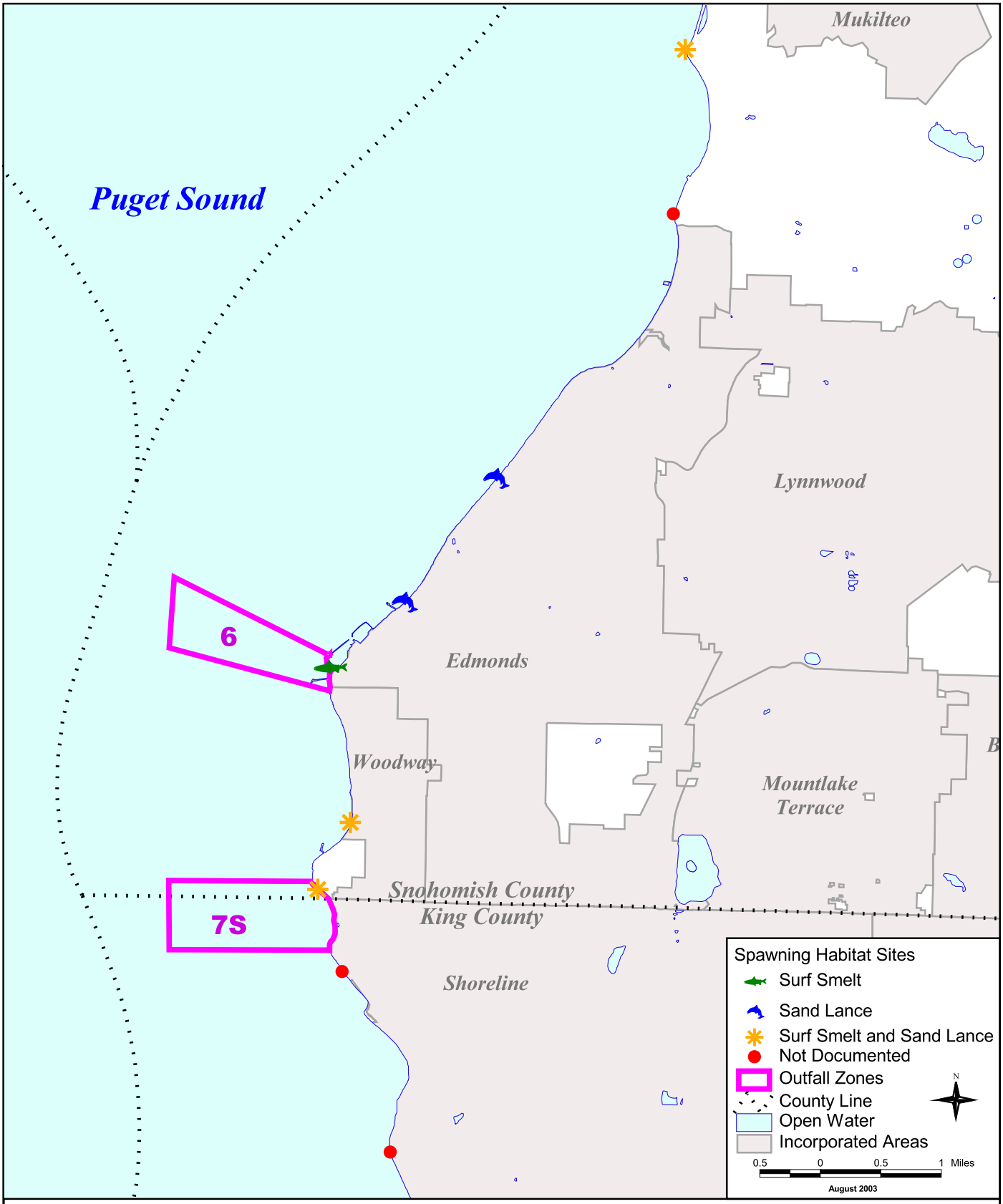
Data Sources: Parametrix, Inc.

File Name: dnrp1:\WTD\Projects\MOSS\projects\eelgrass_transects.apr Shari Cross

Figure 7-27

Outfall Zone 6
Mean Eelgrass Density

BRIGHTWATER FINAL EIS



King County
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Wastewater Treatment Division

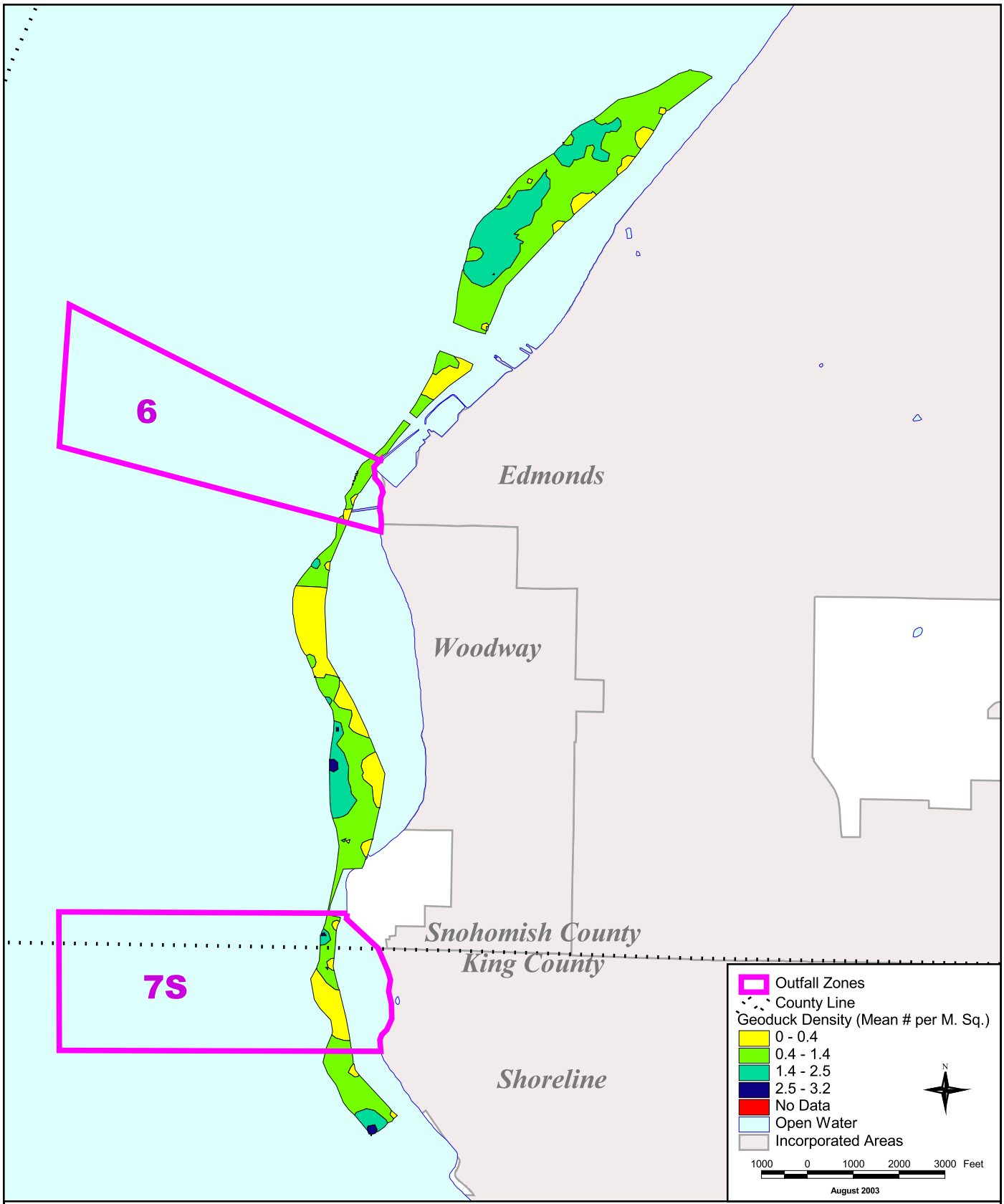
Data Sources: King County 2002a

File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\spawning_feis.apr Shari Cross

Figure 7-28

Documented Sand Lance and Surf Smelt Spawning Habitat Sites

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

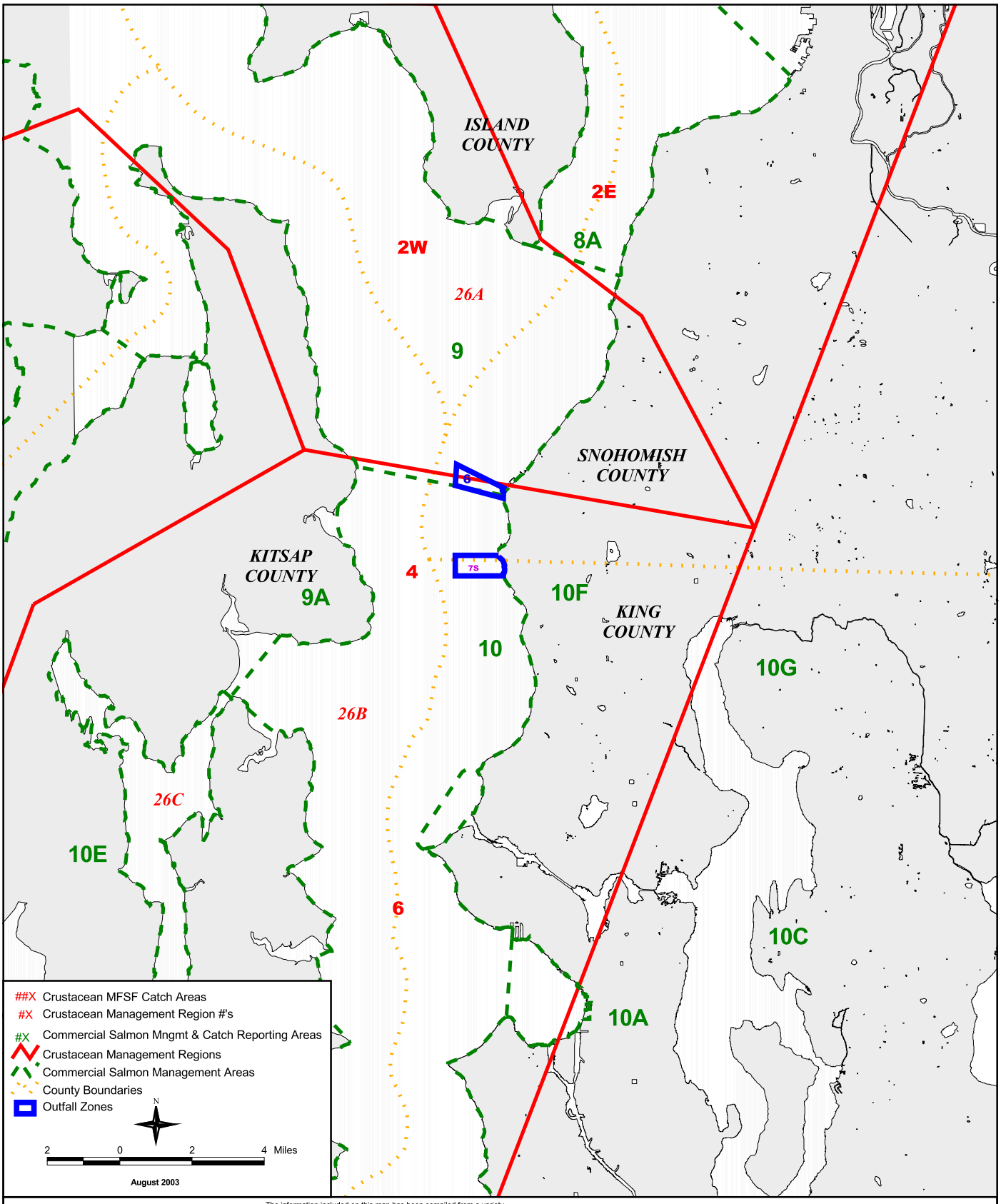
Data Sources: Golder Associates 2002

File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\geoduckdens_feis.apr Shari Cross

Figure 7-29

Geoduck Abundance and Distribution in Candidate Outfall Zones and Vicinity

BRIGHTWATER FINAL EIS



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

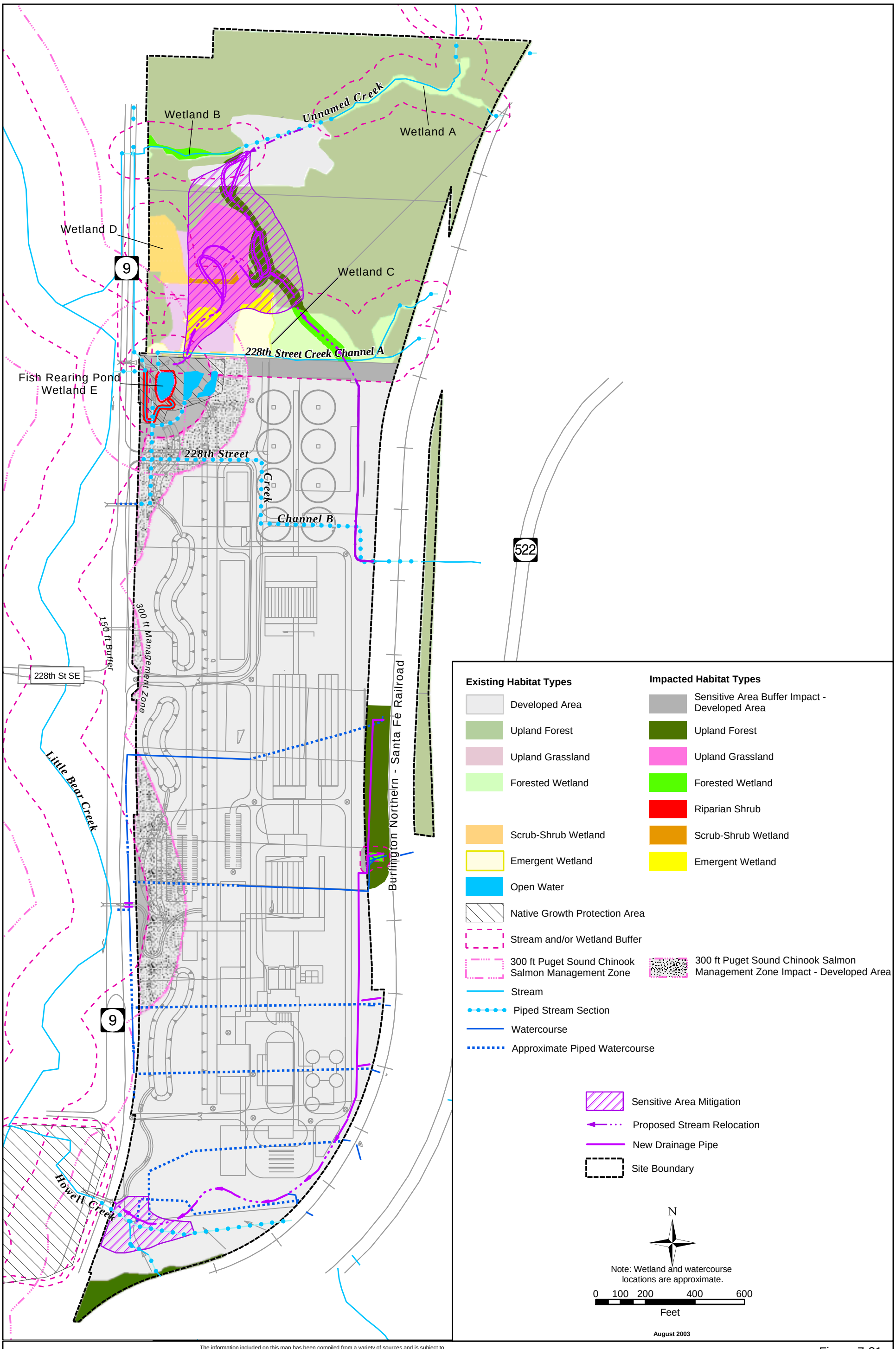
Data Sources: WDFW; King County

File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\mngmtareas_feis.apr Shari Cross

Figure 7-30

Salmon and Crustacean Management Areas in the Candidate Outfall Zones and Vicinity

BRIGHTWATER FINAL EIS



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King County
Department of
Natural Resources and Parks
Wastewater Treatment
Division

Data Sources: watercourses, Snohomish County GIS(2002) and field observations (Adolfson Assoc., 2002),and CADD survey (CH2MHill, 2002); wetland delineations (Adolfson, 2003; Terra Associates, 2002), other field observations (Adolfson, 2002)

File Name: EISsr9site_impact.mxd **Prepared by: Adolfson Associates, Inc.**

Figure 7-31

Potential Impacts to Plants and Animals, and Conceptual Mitigation at the Route 9 Site

BRIGHTWATER FINAL EIS

King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources:King County Aerial, 2000; Snohomish GIS, 1999, Wetland and stream boundaries, CH2MHill, 1997

File Name: ElSunosite_impact.mxd **Prepared by: Adolfson Associates, Inc.**

0 100 200 400
Feet

Figure 7-32

Potential Impacts to Plants and Animals, and Conceptual Mitigation at the Unocal Site (54 mgd)

BRIGHTWATER FINAL EIS

Existing Habitat Types

- Developed Area
- Upland Forest
- Upland Shrub
- Forested/Scrub-Shrub Wetland
- Saltwater Marsh (Estuary)
- Emergent Wetland
- Open Water
- Marine Nearshore
- Stream/Wetland Buffer
- Stream
- Piped Stream Section

Impacted Habitat Types

- Developed Area
- Upland Forest
- Upland Shrub
- Forested/Scrub-Shrub Wetland

Sensitive Area Mitigation

- Sensitive Area Mitigation
- Proposed Willow Creek Daylighting/Relocation
- Site Boundary

October 2003

N

Edmonds Marsh
Wetland A

Wetland B

Wetland C

Willow Creek

Willow Creek

Proposed Willow Creek Daylighting Concept

Burlington Northern - Santa Fe Railroad

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King County
Department of
Natural Resources and Parks
Wastewater Treatment
Division

Data Sources:King County Aerial, 2000; Snohomish GIS, 1999, Wetland and stream boundaries, CH2MHill, 1997

File Name: ElSunosite72mgd_impact.mxd **Prepared by: Adolfson Associates, Inc.**

0 100 200 400
Feet

Figure 7-33

Potential Impacts to Plants and Animals, and Conceptual Mitigation at the Unocal Site (72 mgd)

BRIGHTWATER FINAL EIS